Simplot

J.R. Simplot Company
P.O. Box 912,
Pocatello, Idaho 83204

208 235-5600 Business

April 6, 2020

Arthur Burbank
Remedial Project Manager
Forest Service Intermountain Region
4350 South Cliffs Drive
Pocatello, ID 83204

Subject: Smoky Canyon Mine Remedial Investigation/Feasibility Study (RI/FS)
Draft Feasibility Study Technical Memorandum #2:
Development, Screening, and Detailed Analysis of Remedial Alternatives

Dear Art,

Please find attached the complete *Draft Feasibility Study Technical Memorandum #2: Development, Screening, and Detailed Analysis of Remedial Alternatives* (FSTM#2) for the Smoky Canyon Mine RI/FS. Simplot is submitting the attached document in accordance with the August 2009 Settlement Agreement and Order on Consent/Consent Order (ASAOC). Due to the COVID-19 stay-at-home order we are unable to produce hard copies of the document at this time but will provide copies on request after the order is lifted. Please note that Attachment 2 of Appendix A is too large to email; the attachment is available on the website.

This document can be downloaded at the website:

(b) (6)

Username: (b) (6)
Password (case sensitive): (b) (6) *

Please contact me if there are questions regarding this submittal.

Sincerely,

Jeffrey Hamilton
Environmental Engineer

cc:
Sherri Stumbo – USFS, email only
Rick McCormick – Jacobs, email only
Allan Erickson – Jacobs, email only
Doug Scott – Jacobs, email only
Ralph Oborn – IDEQ, email only
Brady Johnson – IDEQ, email only
Tracy Rita – IDEQ, email only
Colleen O’Hara – BLM, email only

Rebecca Chu – USEPA, email only
Sandi Fisher – USFWS, email only
Ryan Braham – USFWS, email only
Kelly Wright –Shoshone-Bannock Tribes, email only
Susan Hanson – Shoshone-Bannock Tribes, email only
Gary Billman – IDL, email only
Alan Prouty – J.R. Simplot Company, email only
Dedra Williams – J.R. Simplot Company, email only
Lori Lusty – J.R. Simplot Company, email only
Chad Gentry – J.R. Simplot Company, email only
Ron Quinn – J.R. Simplot Company, email only
Andy Koulermos – Formation Environmental, email only
Myra Lugsch – Formation Environmental, email only

DRAFT

Smoky Canyon Mine RI/FS

Feasibility Study Technical Memorandum #2: Development, Screening, and Detailed Analysis of Remedial Alternatives

April 2020

Prepared for:

J.R. Simplot Company
Smoky Canyon Mine
1890 Smoky Canyon Road
Afton, Wyoming 83110

Prepared by:

FORMATION ENVIRONMENTAL
2500 55th Street, Suite 200
Boulder, Colorado 80301

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ACRONYMS

95UCL	95% Upper Confidence Limit of the Mean
AG	Alluvial Groundwater (Remedial Alternatives)
ARAR	Applicable or Relevant and Appropriate Requirement
BLM	United States Department of Interior Bureau of Land Management
BW	body weight
CBL	Capillary Break Layer
CCBE	Covers with Capillary Barrier Effect
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CO	Consent Order
COC	Chemical of Concern
COPC	Chemical of Potential Concern
DSR	Data Summary Report
EDS	Energy Dissipation Structure
EIS	Environmental Impact Statement
FBR	Fluidized Bioreactor
FSTM	Feasibility Study Technical Memorandum
FWS	United States Department of Interior Fish and Wildlife Service
gpm	gallons per minute
GRA	General Response Action
HDPE	High-Density Polyethylene
ICIAP	Institutional Control Implementation and Assurance Plan
ICs	Institutional Controls
IDAPA	Idaho Administrative Procedures Act
IDEQ	Idaho Department of Environmental Quality
LOAEL	Lowest-Observed-Adverse-Effect-Level
MCL	Maximum Contaminant Level
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MNA	Monitored Natural Attenuation
MRL	Moisture Retention Layer

MVP	Minimum Viable Population
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NOAEL	No-Observed-Adverse-Effect-Level
NTCRA	Non-Time-Critical Removal Action
ODA	Overburden Disposal Area
O&M	Operations and Maintenance
PRB	Permeable Reactive Barrier
PRG	Preliminary Remediation Goal
PV	Pore Volume
PVA	Population Variables Analysis
QA/QC	Quality Assurance/Quality Control
RAO	Remedial Action Objective
RI/FS	Remedial Investigation/Feasibility Study
RO	Reverse Osmosis
ROD	Record of Decision
ROM	Run-of-Mine
S	Solids and Soils (Remedial Alternatives)
Simplot	J.R. Simplot Company
SOW	Statement of Work
SSERA	Site-Specific Ecological Risk Assessment
SW	Surface Water (Remedial Alternatives)
TBC	To Be Considered
Tribes	Shoshone-Bannock Tribes
TRV	Toxicity Reference Value
UF	Ultrafiltration
USEPA	United States Environmental Protection Agency
USFS	United States Department of Agriculture Forest Service
WG	Wells (Formation) Groundwater (Remedial Alternatives)
WTP	Water Treatment Plant

1.0 INTRODUCTION

J.R. Simplot Company (Simplot) entered into an Administrative Settlement Agreement and Order on Consent/Consent Order (Settlement Agreement/CO) for Performance of Remedial Investigation and Feasibility Study (RI/FS) at the Smoky Canyon Mine (Mine or Site) with the United States Department of Agriculture, Forest Service Region 4 (Forest Service [USFS]), United States Environmental Protection Agency, Region 10 (USEPA), and Idaho Department of Environmental Quality (IDEQ) (USFS, USEPA, and IDEQ 2009). The Forest Service is the lead agency, and the USEPA, IDEQ, United States Department of Interior Fish and Wildlife Service (FWS) and Bureau of Land Management (BLM), and the Shoshone-Bannock Tribes (Tribes) participate as support agencies. The RI/FS is being conducted pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) in accordance with USEPA's Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA 1988). The RI for the Smoky Canyon Mine was completed in 2014 and the findings are detailed in the Final RI Report (Formation 2014a). This document describes the process of assembling remedial alternatives and conducting a screening evaluation and a detailed analysis of remedial alternatives for the Smoky Canyon Mine as part of the FS.

1.1 Purpose

The general objective of the FS is to identify and evaluate alternatives for remedial action to eliminate, reduce, or control risks to human health and the environment. As per the Settlement Agreement/CO and subsequent correspondence, the FS Report consists of two components submitted as two separate deliverables: (1) the development and screening of remedial alternatives and (2) the detailed analysis of alternatives. FS Technical Memorandum #1 (FSTM#1, Formation 2019c), which is the first component of the FS process and was approved by the Agencies on December 4, 2019 (USFS 2019), identified and screened a range of remedial technologies and process options by media. In accordance with September 8, 2017 Agency comments on the Draft FSTM#1 (USFS 2017), this technical memorandum (Draft FSTM#2), which is the second component of the FS process, includes some of the elements set out in Section 8.a. of the Statement of Work (SOW) (assemble, refine, and screen remedial alternatives) and all of the elements in Section 8.b. of the SOW (detailed analysis of remedial alternatives). FSTM#1 and FSTM#2 comprise the FS Report for the Smoky Canyon Mine.

FSTM#1 for the Smoky Canyon Mine contains the following information:

- A description of the Site setting and physical characteristics, mining and reclamation activities, the 2006 water management non-time-critical removal action (2006 NTCRA) and 2013 Dinwoody/Chert cover NTCRA (2013 NTCRA) at the Pole Canyon overburden disposal area (ODA), and various pilot treatability studies conducted over the years including the Hoopes Water Treatment Plant (WTP) pilot study at Hoopes Spring.

- Key findings of the RI Report including the nature and extent of contamination, fate and transport of selenium and other chemicals of potential concern (COPCs), and a conceptual model.

- Results of the Site-specific human health, ecological, and livestock risk assessments and identification of the chemicals of concern (COCs), selenium and arsenic.

- A summary of the environmental conditions of concern, applicable or relevant and appropriate requirements (ARARs), and remedial action objectives (RAOs) that address key environmental issues at the Site.

- Development of preliminary remediation goals (PRGs) for cleanup of the Site, which include maximum contaminant levels (MCLs) for selenium (0.05 milligrams per liter [mg/L]) and arsenic (0.01 mg/L) in groundwater and non-regulated surface water (Idaho Administrative Procedures Act [IDAPA] 58.01.11); Site-specific water quality standards for selenium in regulated surface water (16.7 micrograms per liter [µg/L] for Hoopes Spring and Sage Creek; 4.2 µg/L for Crow Creek)[1] (IDAPA 58.01.02 – Water Quality Standards); and risk-based PRGs for arsenic in soil (11 milligrams per kilogram [mg/kg]).

- Identification of general response actions (GRAs) and remedial technologies and process options for each GRA. An initial screening of technologies/process options based on technical implementability. A second more detailed screening of retained technologies/process options for effectiveness, implementability, and cost. And a third screening and evaluation of retained technologies/process options for effectiveness, implementability, and cost by media.

In this document, various combinations of technologies and process options are assembled into media-based remedial alternatives. Remedial alternatives were initially screened based on effectiveness, implementability, and cost. The alternatives retained for further consideration were evaluated independently in the detailed analysis with respect to the threshold and balancing evaluation criteria (USEPA 1988) and were then compared to the other alternatives in the comparative analysis. The results of the detailed and comparative analyses are presented in this document, which is FSTM#2. The evaluation considers all areas where overburden from historical mining activities is present.

1.2 Rationale for Media-Based Approach

In accordance with USEPA guidance (USEPA 1988), alternatives for specific media and areas within a site either can be carried through the FS process separately or combined into comprehensive alternatives for the entire site. This approach is flexible and allows alternatives for each media to be combined at various points in the process. For the Smoky Canyon Mine, because of the number of different media involved in the process (i.e., Wells Formation

[1] Note that while the discussion in this document focusses on water concentrations, the tissue-based portion of the standard supersedes the water standard and will be ultimately be used to determine compliance.

groundwater, surface water, alluvial groundwater, and solids and soil) remedial alternatives were developed and evaluated separately by media in the initial screening step.

1.3 Document Organization

This document is organized as follows:

- Section 2 describes the remedial alternatives and summarizes the screening evaluation.
- Section 3 presents the detailed analysis of remedial alternatives.
- Section 4 presents the comparative analysis of remedial alternatives.
- Section 5 presents the recommended remedy for the Site.
- Section 6 lists references and data sources used to develop this technical memorandum.

The appendices are:

- Appendix A – Model Development Report for Wells Formation Groundwater
- Appendix B – Cost Estimate for Remedial Alternatives
- Appendix C – Statistical Analysis of Soil Data

2.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

Remedial technologies and process options retained after the screening process in FSTM#1 were assembled into media-based remedial alternatives to address contamination of groundwater, surface water, and solids and soils and meet RAOs. The primary objective being to develop an appropriate range of remedial alternatives that will protect human health and the environment and meet ARARs. Table 2-1 summarizes the remedial technologies and process options retained for groundwater, surface water, and solids and soils.

Remedial alternatives were evaluated using a qualitative process to determine overall effectiveness, implementability, and cost. As per USEPA guidance (USEPA 1988), the purpose of the screening was to reduce the number of candidate remedial alternatives to a smaller more manageable number. The alternatives judged as the best were carried forward into the detailed analysis of alternatives in Section 3.

2.1 Screening Criteria

As described in USEPA guidance for RI/FS (USEPA 1988), each alternative was evaluated against the short- and long-term aspects of three broad criteria: effectiveness, implementability, and cost. Because the purpose of the screening evaluation was to reduce the number of alternatives that undergo a more thorough and extensive analysis, alternatives were evaluated more generally in this phase than during the detailed analysis. However, the screening evaluation was sufficiently detailed to distinguish among alternatives.

The evaluation criteria for screening are as follows:

<u>Effectiveness</u> – Under the effectiveness evaluation, each alternative was assessed for its ability to provide protection of human health and the environment and to meet ARARs. Each alternative was evaluated for the reductions in toxicity, mobility, or volume it would achieve through treatment. Both short- and long-term components of effectiveness were evaluated. Short-term effectiveness refers to the construction and implementation period, and long-term effectiveness refers to the period after the remedial action has been completed.

<u>Implementability</u> – Under the implementability evaluation, the technical and administrative feasibility of constructing, operating, and maintaining each alternative was evaluated. Technical feasibility refers to the ability to construct, reliably operate, and meet technology-specific regulations for process options until the remedial action has been completed. It also includes operations and maintenance (O&M), replacement, and monitoring of technical components of an alternative after the action has been completed. Administrative feasibility refers to the ability to

obtain approvals from other offices and regulatory agencies and the availability of services, capacity, equipment, and technical specialists.

Cost – The cost evaluation compared the relative costs of the alternatives. Costs in this screening step are typically not defined with the same level of accuracy as in the detailed analysis (i.e., +50% to -30%); however, the relative accuracy of the estimates is consistent so that cost decisions among alternatives is sustained as the accuracy of cost estimates improves beyond the screening process.

2.2 Modeling of Selenium Transport in Wells Formation Groundwater

The analytical model developed under the RI as part of the characterization of the fate and transport of COPCs in Wells Formation groundwater at the Site (Formation 2014a, Appendix H) was updated and used to evaluate the relative effectiveness of various remedial alternatives, both during the initial screening step and as part of the detailed analysis of alternatives. Updates to the RI analytical model, which were discussed with the Agencies in a meeting on December 18, 2018, are described in Appendix A. The updated analytical model is referred as the "Groundwater Model" hereafter.

The Groundwater Model was developed to evaluate selenium transport in the Wells Formation and to provide the ability to evaluate the relative contribution of selenium from each of the sources potentially contributing to the selenium mass load discharged at Hoopes Spring and South Fork Sage Creek springs (the spring complex). Source areas include Panels A, B, C, D, and E (and associated external ODAs), and the Pole Canyon ODA. The model accounts for changes in the relative contributions from these different source areas over time as mining and final overburden disposal/reclamation were implemented. Thus, the model provides a Site-wide assessment of the relative spatial and temporal role of multiple source areas on spring discharges. It is important to recognize that the Groundwater Model produces "relative" estimates of selenium loading contributions. The primary updates to the Groundwater Model since the RI are as follows:

- Data and information from detailed groundwater flow and contaminant transport modeling analyses performed as part of the East Smoky Environmental Impact Statement (EIS) (HGG 2018) were integrated for consistency.

- Panel B is assumed to be reclaimed conservatively in year 2030 with the currently approved topsoil and chert cover. The selenium source concentration for Panel B overburden is conservatively assumed to be consistent with the "north-end" concentration function developed in the RI modeling analyses (see Formation 2014a, Section 7.3.2.1). This source term function results in a higher estimated selenium concentration compared to source concentration estimates of East Smoky overburden, assuming either the Proposed Action or Reduced Pit Shell alternatives (see HGG 2018, Section 6.3).

- Data and information from the Deep Dinwoody lysimeter monitoring (O'Kane Consultants 2019) were used to inform percolation rate estimates of covers at the Site.

- The empirically based, time-varying, selenium concentration function (i.e., source term) was updated for consistency with methods used in National Environmental Policy Act (NEPA) modeling analyses, Site-specific column test analyses, and revised net infiltration estimates.

- Post-RI groundwater and surface water monitoring data augmented the data set used in the model calibration process.

Selenium loading assumptions (i.e., processes affecting mobilization and transport) from source areas were treated consistently between source areas. Therefore, evaluation of selenium loading to the springs by source area should consider the simplifying assumptions relative to conditions unique to each source area. For example, differences in snow accumulation and infiltration of precipitation, degree of weathering in specific ODAs, attenuation potential in the vadose zone (unsaturated Wells Formation and undisturbed colluvial/hillslope deposits), selenium transport times through the unsaturated zone, and discrete fractured zones in pit floors were not represented in the model but could have significant effects on magnitudes and timing of selenium loads arriving and dissipating from the springs. Instead, the Groundwater Model assumed solute transport in the Wells Formation is similar to transport in a porous medium, sorption does not occur, groundwater flow was constant and seasonal fluctuations were not represented, and the release of selenium over time was estimated using Site-specific data and estimated net percolation rates through covers. Site-specific knowledge has been considered in the identification of remedial alternatives.

2.3 Description and Screening of Remedial Alternatives

The following sections provide descriptions of the media-based remedial alternatives and the results of the screening process for Wells Formation groundwater, surface water, alluvial groundwater, and solids and soils. A summary of the screening evaluation is provided in Tables 2-2 through 2-5. The cost estimates for remedial alternatives are provided in Appendix B.

Under all alternatives, O&M and groundwater/surface water monitoring for the 2006 and 2013 NTCRAs at the Pole Canyon ODA would continue as per the existing Settlement Agreements (USFS, USEPA and IDEQ 2006; USFS, IDEQ and Tribes 2013). Therefore, this action is not discussed further in this section, but will be considered in the detailed analysis in Section 3.

2.3.1 Remedial Alternatives for Wells Formation Groundwater

Releases of COCs from overburden (both during mining and after mining) stored in backfilled pits and external ODAs with minimal or no covers have resulted in concentrations of selenium and arsenic above their MCLs in groundwater in the Wells Formation aquifer. There is a potential risk to people (hypothetical resident) if this groundwater is used as a domestic drinking water supply on private lands (i.e., Simplot-owned land in Sage Valley) in the future. Wells Formation groundwater generally flows north to south and discharges to surface water at Hoopes Spring and South Fork Sage Creek springs. This discharge results in selenium concentrations above the State of Idaho Surface Water Quality Criterion for Aquatic Life in Sage Creek and Crow Creek.

The rate of selenium release after mining depends on location specific conditions; primarily the setting, areal extent of the overburden and the cover placed on it. The relative magnitude of selenium loading to Wells Formation groundwater is proportional to net infiltration rates through overburden. In addition, the timing of any effect on selenium load discharging at the springs depends on the distance from the overburden to the springs. Simplot evaluated Site conditions and identified 3 areas that are primary candidates for covers: Panels D-1, and E-1n and the D Panel external ODA (Figure 2-1) (these are collectively termed “target cover areas” in this report). These areas are estimated to have relatively high net infiltration rates through overburden and are close to the springs such that effects of covers on the selenium load in groundwater discharging at the spring complex would be realized in a relatively short timeframe (as compared to Panel A, which is estimated to have a groundwater travel time to the springs of 25 to 30 years).

The RAOs for Wells Formation groundwater are:

- Prevent future use of Wells Formation groundwater with arsenic or selenium concentrations above MCLs as a drinking water source.
- Reduce or eliminate concentrations of arsenic and selenium in contaminated Wells Formation groundwater to below MCLs within a reasonable time frame given the circumstances of the Site.
- Reduce or eliminate loading of selenium from groundwater to surface water so that it does not result in concentrations that represent an unacceptable risk to aquatic life and complies with ARARs (IDAPA 58.01.02 – Water Quality Standards) in the lower Sage Creek and Crow Creek watersheds.

Remedial alternatives for Wells Formation groundwater were assembled by combining the retained remedial technologies that are capable of addressing the RAOs. The screening evaluation of alternatives for Wells Formation groundwater is summarized in Table 2-2 and described below.

The remedial alternatives evaluated for Wells Formation groundwater (WG) are:

- Alternative WG-1 – No Further Action
- Alternative WG-2 – Monitored Natural Attenuation (MNA)
- Alternative WG-3 – Institutional Controls (ICs)
- Alternative WG-4 – 5-Foot Dinwoody or Salt Lake Formation/Chert Covers, ICs and MNA
- Alternative WG-5 – Capillary Covers, ICs and MNA
- Alternative WG-6 – Enhanced Dinwoody Covers, ICs and MNA

- Alternative WG-7 – Geomembrane Covers, ICs and MNA

2.3.1.1 Alternative WG-1 – No Further Action

Description

No additional actions would be taken under Alternative WG-1.

Screening Evaluation

Effectiveness – Low

During the RI (2009–2010), arsenic concentrations were measured above the MCL in Wells Formation groundwater at GW-16 (located near the mouth of Pole Canyon as shown in Figure 2-2). Monitoring after 2014 has shown that all concentrations are below the MCL (Figure 2-3). The 2006 NTCRA at the Pole Canyon ODA (implemented in 2007 and 2008) significantly reduced the volume of water that was entering the ODA, particularly the inflow of Pole Canyon Creek, and consequently has reduced the mass of COCs released. This has had the effect of reducing arsenic concentrations to below the MCL in Wells Formation groundwater such that human health is protected for the No Further Action alternative (O&M of the Pole Canyon NTCRAs will continue as per the existing Settlement Agreements [USFS, USEPA, and IDEQ 2006; USFS, IDEQ, and Tribes 2013]). Therefore, arsenic is not discussed further in this analysis for Wells Formation groundwater.

Alternative WG-1 would not be protective of human health because groundwater with selenium concentrations above the MCL could be used as a source of drinking water on Simplot-owned land in Sage Valley in the future. There are no environmental risks associated directly with Wells Formation groundwater. The groundwater discharges to surface water at the spring complex. Environmental risks associated with surface water are described in Section 2.3.2.

Under Alternative WG-1, no additional response actions would be implemented. The Groundwater Model estimates that mass flux of selenium from the ODAs to Wells Formation groundwater will reduce over time (Figure 2-4). This is expected to result in a general reduction in selenium concentrations in groundwater, with specific effects being dependent on the physical location of the well screen relative to source areas and groundwater flow paths. While groundwater conditions are expected to improve over time, it is uncertain whether selenium concentrations will ultimately reduce to below the MCL at all monitoring locations over the long term.

Implementability – High

No additional actions would be implemented. There are no implementability issues with this alternative.

Cost – Low

There are no additional response actions under Alternative WG-1 and therefore there is no cost.

<u>Screening Result</u>

No further action is RETAINED as required by the NCP.

2.3.1.2 Alternative WG-2 – Monitored Natural Attenuation (MNA)

<u>Description</u>

Alternative WG-2 consists of MNA to reduce contamination in Wells Formation groundwater. MNA relies on natural processes to contribute to the reduction of selenium concentrations in groundwater in areas where release and transport have already occurred. MNA can occur through natural physical (e.g., dilution, dispersion, sorption), geochemical (e.g., sorption, precipitation), and/or biochemical (biologically mediated reduction) processes. Depending on the chemical conditions of the aquifer, the MNA process would reduce selenium concentrations in Wells Formation groundwater along existing flow pathways over time.

Long-term groundwater monitoring would be required to track MNA progress over time.

<u>Screening Evaluation</u>

Effectiveness – Low

Human health would not be protected because groundwater with selenium concentrations above the MCL could be used as a source of drinking water on Simplot-owned land in Sage Valley in the future. There are no environmental risks associated directly with Wells Formation groundwater.

Hay et al. (2016) evaluated the release and subsequent transport of selenium leached from overburden at multiple phosphate mines in southeastern Idaho, with a particular emphasis on understanding conditions leading to selenium attenuation. They hypothesized that selenium released in the oxic upper portions of overburden disposed in backfilled pits can subsequently be attenuated by reductive precipitation at depth in unsaturated, low oxygen portions of the waste rock. This is an important mechanism by which elevated concentrations of selenium may be naturally attenuated within the waste rock prior to discharging to groundwater and surface water.

They found that comparing the ratio of selenium to sulfate, as well as the concentration of redox sensitive parameters (dissolved oxygen, dissolved iron, dissolved manganese) in groundwater samples to those of saturated and unsaturated column tests were valuable in understanding selenium release and attenuation.

The concentrations of total selenium, sulfate, dissolved iron, dissolved manganese, and dissolved oxygen measured in select wells, spring and seeps are summarized in Table 2-6. The ratio of total selenium to sulfate for Wells Formation groundwater, and spring/seep water are shown on Figures 2-5 and 2-6, respectively. The upper and lower bounds of the unsaturated column tests as reported by Hay et al. (2016) are also shown for comparison. As shown, the ratio of selenium to sulfate in Wells Formation groundwater and spring/seep water is generally consistent with the unsaturated column tests (ratios occur within the upper and lower bounds of the unsaturated column tests), indicating that, with the exception of dispersion and dilution, limited natural attenuation of selenium is occurring in Wells Formation groundwater at the Smoky Canyon Mine. Relatively high dissolved oxygen and low concentrations of dissolved iron and manganese also suggest oxic conditions with limited natural attenuation due to reductive precipitation. Tetra Tech (2008) evaluated waste rock borehole pore gas concentrations at the Smoky Canyon Mine and found that pore gas oxygen remained relatively high (10 to 20%) with depth in Smoky Canyon waste rock within the two boreholes tested. These results indicate less oxygen consumption within the waste rock and/or a greater degree of contact and exchange with the atmosphere. The pore gas results suggest conditions measured at that time in the limited locations would not support natural attenuation of selenium within waste rock at the Smoky Canyon Mine, likely due to Site-specific factors or disposal practices.

Although local column tests suggested that MNA processes are not currently having a significant effect on selenium mass flux (and concentrations) in Wells Formation groundwater, conditions in waste rock within pit backfill and external ODAs are variable and may become less oxic over time. Therefore, natural attenuation may be effective in groundwater and may result in a reduction of selenium concentrations over time.

Implementability – High

No remedial construction or maintenance would be required and MNA would be easy to implement. Long-term monitoring of MNA would be technically feasible.

Administrative requirements for development and implementation of a new long-term groundwater monitoring plan to evaluate the effectiveness of MNA would be implementable.

Cost – Low

There are no capital costs for MNA.

Screening Result

It appears that the geochemical attenuation mechanism does not currently limit the extent of selenium transport from source areas, and natural attenuation may offer only limited reductions in selenium concentrations in groundwater downgradient of those sources. However, conditions in waste rock within pit backfill and external ODAs are variable and may become less oxic over time, which may have an effect on groundwater conditions. Therefore, natural attenuation may be effective and may result in a reduction of selenium concentrations over time. MNA is RETAINED in conjunction with other remedial alternatives (i.e., source control) for the detailed analysis.

2.3.1.3 Alternative WG-3 – Institutional Controls (ICs)

Description

Under Alternative WG-3, ICs (deed restrictions) would be put in place to prevent the use of Wells Formation groundwater with selenium concentrations greater than the MCL as a source of drinking water on Simplot-owned land in Sage Valley.

Deed restrictions are rules and regulations that govern one or more parcels of land. They are recorded with the county and are permanent and "run with the land," so they bind current and future owners. Specific performance objectives (e.g., prevent access or use of Wells Formation groundwater until cleanup levels are met) would be included in the Record of Decision (ROD) and then specified as restrictions on the property deed.

ICs would require preparation of an IC Implementation and Assurance Plan (ICIAP) to establish and document the activities necessary to implement and ensure the long-term stewardship of ICs; and specify the organization responsible for conducting these activities. As described in USEPA guidance on ICs (USEPA 2012), the ICIAP would focus on the details of how the deed restrictions would be implemented, maintained, enforced, modified, and terminated (if applicable). Deed restrictions would only be applied to areas where selenium concentrations exceed the MCL and would ultimately be removed when the MCL is met throughout Simplot-owned land in Sage Valley.

Screening Evaluation

Effectiveness – Moderate

Deed restrictions to prevent use of groundwater with selenium concentrations above the MCL as a domestic water supply on Simplot's land in Sage Valley would protect human health. There are no environmental risks associated directly with Wells Formation groundwater.

The same reduction of selenium concentrations would occur over time for Alternative WG-3 as for Alternative WG-1, described above.

Implementability – High

Implementation of ICs would be technically and administratively feasible.

Cost – Low

The estimated capital cost for implementation of ICs is $50,000.

Screening Result

ICs would provide immediate protection of human health by preventing use of Wells Formation groundwater with selenium concentrations above the MCL as a drinking water source on Simplot-owned land in Sage Valley. This alternative is RETAINED for the detailed analysis.

2.3.1.4 Alternative WG-4 – 5-Foot Dinwoody or Salt Lake Formation/Chert Covers, ICs and MNA

Description

Under this alternative, a 5-foot-thick Dinwoody or Salt Lake Formation/chert cover would be constructed on the target cover areas (194 acres) (Figure 2-1). The purpose of including this type of cover is to provide an assessment of a cover type that is similar to the one constructed at the Pole Canyon ODA as part of the 2013 NTCRA.

The covers would consist of two layers that would be used to reduce infiltration of water into the overburden and allow drainage of storm water and snowmelt off the ODA (Figure 2-7). Target cover areas could be graded as necessary for cover construction. The cover would consist of an approximately 2-foot layer of chert or limestone overlain by an approximately 3-foot soil layer of Dinwoody Formation or Salt Lake Formation material, or equivalent. The cover would be vegetated with native grass/forb species to control erosion. Erosion control measures (e.g., wattles, silt fences, etc.) would be installed on the cover system to prevent damage to the cover due to snowmelt and surface runoff.

Storm water run-on and runoff controls would be constructed as needed to convey water off or around the cover areas. These controls would consist of channels, spillways, sedimentation basins, and/or infiltration basins. Channels and spillways would be lined with riprap as needed to prevent erosion.

Monitoring of the covers would be implemented to ensure their effectiveness over the long term. Inspections would be conducted to monitor settlement and erosion of the cover system, vegetative growth, and integrity of the storm water control systems. O&M would be required to maintain the effectiveness and permanence of the cover system and other remedy components.

ICs under Alternative WG-4 would be the same as Alternative WG-3. MNA would be the same as described under Alternative WG-2. Long-term groundwater monitoring would be required to evaluate the effectiveness of the remedial alternative.

Screening Evaluation

Effectiveness – Moderate to High

Alternative WG-4 would have the same effectiveness for protection of human health as Alternative WG-3 due to the implementation of ICs to prevent the use of Wells Formation groundwater with selenium concentrations above the MCL as a source of drinking water on Simplot-owned land in Sage Valley. There are no environmental risks associated directly with Wells Formation groundwater.

Installing a 5-foot Dinwoody or Salt Lake Formation/chert cover is estimated to reduce the infiltration of water for an average precipitation year by 29% (see Appendix A). This would lead to a similar reduction of selenium releases at the target cover areas and would be expected to reduce selenium concentrations in Wells Formation groundwater in the vicinity in addition to reductions estimated to occur without additional action (see Section 2.3.1.1). Construction of the similar Dinwoody/chert cover system at the Pole Canyon ODA under the 2013 NTCRA has been demonstrated to have an effect on selenium concentrations in the environment (Formation 2019d, 2020). Concentrations of selenium released from the ODA as measured by concentrations at the toe seep (LP-1) have decreased and selenium concentrations in Wells Formation groundwater downgradient of the ODA at GW-16 have also decreased since the cover was installed (see Section 3.2.1.1).

Implementability – High

Construction of Dinwoody or Salt Lake Formation/chert covers would be technically feasible and would not require specialized construction techniques or special access logistics. Simplot has installed a similar cover at the Pole Canyon ODA. The target cover areas comprise 194 acres and therefore approximately 940,000 cubic yards of Dinwoody or Salt Lake Formation (3-foot thickness) and 630,000 cubic yards of chert (2-foot thickness) would be required for construction of the cover. Sufficient volumes of chert material are expected to be recovered from ongoing mining; however, this may require a phased approach to cover construction to allow the required volume of chert to be generated. The Dinwoody borrow study conducted in 2018 (Simplot 2018) found that material in the potential D-Panel and E-Panel borrow areas (Figure 2-8) was gravelly rock that would be poorly suited for cover material. The estimated recoverable volume of good clay material from the B-Panel Dinwoody borrow areas was less than approximately 3 million cubic yards. Some of the material from the B-Panel borrow area could be required for post-mining reclamation. There is also the potential that active mining at Panels F and G could generate excess Dinwoody material that could be used for CERCLA covers. Another potential option is to source Dinwoody or Salt Lake Formation material from Simplot's private land in Sage Valley (Figure 2-8). All efforts will be made to source Dinwoody material from active mining; however, there is too much uncertainty to make that determination at this time. Therefore, for the purposes of this report, it is assumed that the Sage Valley borrow area will provide Dinwoody or Salt Lake material for the covers. This provides a consistent basis to evaluate the relative performance and cost in the comparative analysis (Section 4).

Cost – Moderate

Estimated capital cost for a 5-foot Dinwoody or Salt Lake Formation/chert cover on the target cover areas (194 acres) is $20 Million.

<u>Screening Result</u>

A 5-foot Dinwoody or Salt Lake Formation/chert cover would reduce infiltration of water into the ODA surface (and subsequent release of selenium to Wells Formation groundwater); however, it has a lower effectiveness than a capillary cover. This alternative is NOT RETAINED for the detailed analysis of alternatives.

2.3.1.5 Alternative WG-5 – Capillary Covers, ICs and MNA

<u>Description</u>

Under this alternative, capillary covers and associated storm water controls would be constructed on the target cover areas (Figure 2-1). The cover concept is shown on Figures 2-7 and 2-9. From surface to base, the cover would consist of:

- 2-feet of uncompacted Dinwoody or Salt Lake Formation with drainage benches at approximately 150 foot spacing (dependent on slope)
- Filter fabric
- 12-inch drainage layer (screened chert/limestone)
- 6-inches of graded Dinwoody or Salt Lake Formation (to provide a working base layer for the construction)
- Graded overburden

A key component of a capillary cover system are drainage benches. Drainage benches remove infiltrated water, which accumulates as lateral flow (or interflow) at the capillary interface (e.g., between the Dinwoody and screened chert), from the cover system and moves the water off the reclaimed slope. The drainage benches also collect surface run-on water and both the interflow water and surface run-on water are managed as clean storm water, which can be directed to key downgradient areas to improve groundwater quality. A geomembrane liner is placed at the bottom of the bench below the drainage material. Spacing of drainage benches varies with the slope of the reclamation cover and, in general, the flatter the slope the closer the bench spacing.

Storm water run-on and runoff controls would be constructed as needed to convey water off or around the cover areas. These controls would consist of channels, spillways, sedimentation basins, and/or infiltration basins. Channels and spillways would be lined with riprap as needed to prevent erosion.

ICs under Alternative WG-5 would be the same as Alternative WG-3. MNA would be the same as described under Alternative WG-2.

Monitoring of the covers would be implemented to ensure their effectiveness over the long term. Inspections would be conducted to monitor settlement and erosion of the cover system, vegetative growth, and integrity of the storm water control systems. O&M would be required to maintain the effectiveness and permanence of the cover system and other remedy components. Long-term groundwater monitoring would be required to evaluate the effectiveness of the remedial alternative.

Screening Evaluation

Effectiveness – Moderate to High

Alternative WG-5 would have the same effectiveness for protection of human health as Alternative WG-3 due to the implementation of ICs to prevent use of Wells Formation groundwater with selenium concentrations above the MCL as a source of drinking water on Simplot-owned land in Sage Valley. There are no environmental risks associated directly with Wells Formation groundwater.

Installing a capillary cover is estimated to reduce the infiltration of water for an average precipitation year by 58% (see Appendix A). This would lead to a similar reduction of selenium releases at the target cover areas and would be expected to reduce selenium concentrations in Wells Formation groundwater in the vicinity in addition to reductions predicted to occur without additional action (see Section 2.3.1.1).

Implementability – High

Construction of capillary covers would be technically feasible and would not require specialized construction techniques or special access logistics. Simplot has installed covers using similar materials at the Smoky Canyon Mine. The target cover areas comprise 194 acres and therefore approximately 780,000 cubic yards of Dinwoody or Salt Lake Formation and 310,000 cubic yards of chert would be required for construction of the cover (with additional Dinwoody or Salt Lake Formation material required to form the working base). Sufficient volumes of chert material are expected to be recovered from ongoing mining. Dinwoody or Salt Lake Formation material may be available from on-going mining but certainly is available from Simplot's private land in Sage Valley (refer to Figure 2-8).

Cost – Moderate

Estimated capital cost for a capillary cover on the target cover areas (194 acres) is $33 Million.

<u>Screening Result</u>

A capillary cover is implementable and would reduce infiltration of water into the ODA surface (and subsequent release of selenium to Wells Formation groundwater) at a higher effectiveness than 5-foot Dinwoody or Salt Lake Formation/chert covers. This alternative is RETAINED for the detailed analysis of alternatives.

2.3.1.6 Alternative WG-6 – Enhanced Dinwoody Covers, ICs and MNA

<u>Description of Alternative</u>

Alternative WG-6 would include construction of Enhanced Dinwoody covers on the target cover areas (Figure 2-1) and associated storm water controls. The Enhanced Dinwoody covers (Figure 2-7) would consist of (from surface to base):

- 1-foot of topsoil
- 2-feet of loose Dinwoody
- Filter fabric
- 12-inch drainage layer (chert/limestone)
- 6-inch of enhanced Dinwoody (screened Dinwoody with 5% bentonite)
- 6-inch screened Dinwoody (3-inch screened material)
- Graded overburden

The cover would be vegetated with native grass/forb species to control erosion. Erosion control measures (e.g., wattles, silt fences, etc.) would be installed on the cover system to prevent damage to the cover due to snowmelt and surface runoff. Storm water run-on and runoff controls would be constructed to convey water off or around the ODAs via channels, spillways, sedimentation basins, and/or infiltration basins.

ICs under Alternative WG-6 would be the same as under Alternative WG-3. MNA would be the same as described under Alternative WG-2. Monitoring and O&M would be performed on the covers to ensure the effectiveness of the remedial actions. Long-term groundwater monitoring would be required to evaluate the effectiveness of the remedial action.

Screening Evaluation

Effectiveness – Moderate to High

Alternative WG-6 would have the same effectiveness for protection of human health and the environment as Alternative WG-3, because deed restrictions would prevent use of groundwater with selenium concentrations above the MCL as a source of drinking water on Simplot-owned land in Sage Valley. There are no environmental risks associated directly with Wells Formation groundwater.

Installing an Enhanced Dinwoody cover is estimated to reduce the infiltration of water for an average precipitation year by up to 95% (see Appendix A). This would lead to a similar reduction of selenium releases at the target cover areas and would be expected to reduce selenium concentrations in Wells Formation groundwater in the vicinity, in addition to reductions predicted to occur without additional action (see Section 2.3.1.1).

Implementability – High

Construction of Enhanced Dinwoody covers would be technically feasible and would not require specialized construction techniques or special access logistics. Simplot has constructed Enhanced Dinwoody covers at Panel F for reclamation after active mining. The target cover areas comprise 194 acres and therefore approximately 630,000 cubic yards of Dinwoody or Salt Lake Formation, 310,000 cubic yards of chert and 310,000 cubic yards of topsoil would be required for construction of the cover. Sufficient volumes of chert material are expected to be recovered from ongoing mining. Dinwoody or Salt Lake Formation material is available from Simplot's private land in Sage Valley (refer to Figure 2-8).

Given the increased number of layers to be constructed with the Enhanced Dinwoody cover system (e.g., the 100% compact screened Dinwoody and bentonite amended layers) it will be difficult to construct more than 30 to 35 acres in a given year at Smoky Canyon Mine, with the limited construction season. This will lead to several years of construction to complete the 194 acres. In order to get 100% compaction on the bottom screened layer a solid compacted base is needed to construct upon. Thus, the run-of-mine (ROM) material currently in the target cover areas will require significant preparation, grading, and compaction before cover construction. This can only occur after the spring melt is completed. Because of this step, and from Simplot's experience, initiation of cover construction of the Enhanced Dinwoody is most likely delayed until July in any construction season. Each layer has to be properly sequenced for the cover system to be effective, thus only relatively small areas can be constructed at a time. For example, the amended Dinwoody layer can only be exposed to the elements for a few days before it needs to be covered with the drainage layer material. This sequencing constraint significantly affects how many acres can be competed each construction season. Another current constraint is how much bentonite can be delivered in a construction season. Only one source for bentonite can be used per season in order for the amended product to be consistent and effective. The bentonite producers in central Wyoming are not setup for mass production of the high quality (Free Swell of +24) bentonite and can only deliver 2 or 3 truckloads of bentonite per day. Because there is well over a month of work to do a section of cover system after the amended layer is completed, this puts additional pressure on having to complete this phase of the project by late August in order to complete the section in a given year. If the seeding and erosion control isn't competed in a construction season, the entire section is at risk of failure going into the winter and spring melt seasons.

Cost – High

Estimated capital cost for an Enhanced Dinwoody cover on the target cover areas (194 acres) is $60 Million.

<u>Screening Result</u>

Enhanced Dinwoody covers have been shown to be effective at Panel F, where they are integrated with placement of overburden generated by active mining. The Enhanced Dinwoody cover performance is similar to geomembrane covers, which are retained for the detailed analysis. To avoid carrying forward too many similar options Enhanced Dinwoody covers are NOT RETAINED for the detailed analysis.

2.3.1.7 Alternative WG-7 – Geomembrane Covers, ICs and MNA

<u>Description of Alternative</u>

Alternative WG-7 would include construction of geomembrane covers on the target cover areas (Figure 2-1) and associated storm water controls. The geomembrane covers would conceptually consist of multiple layers to reduce infiltration into the overburden material, including a geomembrane (Figure 2-7). This layer would be protected and supported by layers of local materials. For example, the cover could include a 1-foot-thick protective subgrade that would be placed on the overburden material to prevent damage to the geomembrane layer and 3 feet of Dinwoody/topsoil on top of the geomembrane layer.

Target cover areas could be graded as necessary for cover construction. Plant species would be selected so that roots would not penetrate the hydraulic barrier layer and enter the underlying overburden material. Erosion control measures (e.g., wattles, silt fences, etc.) would be installed on the cover system to prevent damage to the cover due to snowmelt and surface runoff. Storm water run-on and runoff controls would be required to convey water off or around the ODAs via channels, spillways, sedimentation basins, and/or infiltration basins.

ICs under Alternative WG-7 would be the same as under Alternative WG-3. MNA would be the same as described under Alternative WG-2. Monitoring and O&M would be performed to ensure the long-term effectiveness of the cover systems. Long-term groundwater monitoring would be required to evaluate the effectiveness of the remedial action.

Screening Evaluation

Effectiveness – Moderate to High

Alternative WG-7 would have the same effectiveness for protection of human health and the environment as Alternative WG-3, because deed restrictions would prevent use of groundwater with selenium concentrations above the MCL as a source of drinking water on Simplot-owned land in Sage Valley. There are no environmental risks associated directly with Wells Formation groundwater.

Installing a geomembrane cover is estimated to reduce the infiltration of water for an average precipitation year by 100% in the short term (see Appendix A). This would lead to a similar reduction of selenium releases at the target cover areas and would be expected to reduce selenium concentrations in Wells Formation groundwater in the vicinity, in addition to reductions predicted to occur without additional action (see Section 2.3.1.1). However, the geomembrane has a finite life expectancy because it is composed of man-made materials.

Implementability – Moderate to High

Geomembrane covers can be constructed using specialized construction techniques but can have constructability issues.

Cost – High

Estimated capital cost for a geomembrane cover on the target areas (194 acres) is $74 Million.

Screening Result

Geomembrane covers are effective in reducing infiltration into the ODA surface in the short term, but the geomembrane has a finite life expectancy because it is composed of man-made materials. This alternative is RETAINED for the detailed analysis to provide an analysis of the type of cover that has the potential to provide the highest reduction in infiltration into overburden materials.

2.3.2 Remedial Alternatives for Surface Water

Discharge of Wells Formation groundwater at Hoopes Spring and South Fork Sage Creek springs has resulted in selenium concentrations in surface water above the State of Idaho Surface Water Quality Criterion for Aquatic Life at the springs (HS-3, LSS) and downstream in Sage Creek (LSV-2, LSV-3, LSV-4) and Crow Creek (CC-1A, CC-WY-01) (Figure 2-10).

There is a potential future risk to human receptors (recreational camper or Native American) and current risk to human receptors (Native American) from ingestion of surface water where arsenic concentrations exceeded the Idaho drinking water standard in surface water seeps downgradient (east) of Panel D (DS-7) and the Pole Canyon ODA (LP-1), and surface water in detention ponds downgradient of Panel D seep DS-7 (DP-7) and Panel E (EP-2) (Figure 2-11).

The RAOs for surface water are:

- Reduce or eliminate unacceptable risks to human receptors from ingestion of non-regulated surface water (seeps and detention ponds) due to arsenic.
- Reduce selenium concentrations in lower Sage Creek and Crow Creek watersheds to below levels that pose unacceptable risks for aquatic life and comply with ARARs (IDAPA 58.01.02 – Water Quality Standards).

Remedial alternatives for surface water were assembled by combining the retained remedial technologies and process options that are capable of addressing RAOs. The primary actions are containment (i.e., covers) to reduce the release and transport of selenium from ODA materials to Wells Formation groundwater which discharges to surface water at the spring complex and treatment of the groundwater discharging at the springs to reduce selenium concentrations in downstream surface water. A summary of the screening evaluation of these remedial alternatives is presented in Table 2-3 and described below.

The media-based remedial alternatives for surface water (SW) are:

- Alternative SW-1 – No Further Action
- Alternative SW-2 – 5-Foot Dinwoody or Salt Lake Formation/Chert Covers
- Alternative SW-3 – Capillary Covers
- Alternative SW-4 – Enhanced Dinwoody Covers
- Alternative SW-5 – Geomembrane Covers

- Alternative SW-6 – Treatment of Water Discharging at Hoopes Spring

2.3.2.1 Alternative SW-1 – No Further Action

Description

Under Alternative SW-1, the water treatment pilot study at Hoopes Spring would be terminated and the Hoopes WTP would be removed. No additional actions would be implemented.

Screening Evaluation

Effectiveness – Low

Human health would not be protected because people could ingest non-regulated surface water with arsenic concentrations above the MCL from seeps and detention ponds.

Mass flux of selenium to surface water from discharge of Wells Formation groundwater is anticipated to decrease over time (see Figure 2-12). Consequently, selenium concentrations in surface water (and in fish tissue) downgradient of Hoopes Spring and South Fork Sage Creek springs are also anticipated to decrease over time which would reduce environmental risks. However, it is uncertain whether they will reduce below the surface water quality standards at all monitoring locations in Sage Creek and Crow Creek over the long term.

Implementability – High

No additional actions would be implemented. There are no implementability issues with this alternative.

Cost – Low

There are no additional response actions under Alternative SW-1 and therefore there is no cost.

Screening Result

No further action is RETAINED as required by the NCP.

2.3.2.2 Alternative SW-2 – 5-Foot Dinwoody or Salt Lake Formation/Chert Covers

Description

The cover element of this remedial alternative would be the same as for Alternative WG-4, described in Section 2.3.1.4 (Figure 2-7).

In addition, rock covers would be placed as a physical barrier layer on seeps (DS-7 and LP-1) and detention ponds (DP-7 and EP-2) to prevent direct contact with surface water with arsenic concentrations greater than the MCL. Fences and signs to notify people that drinking the water is potentially unsafe may be installed in the interim to prevent contact.

Long-term surface water monitoring and O&M would be required to evaluate the effectiveness of the alternative.

Screening Evaluation

Effectiveness – Moderate to High

Human health would be protected through the use of fences and/or signs in the short term and ultimately rock covers to prevent ingestion of surface water in seeps and detention ponds with arsenic concentrations greater than the MCL.

Concentrations of selenium in surface water in Sage Creek and Crow Creek downstream of Hoopes Spring are anticipated to decrease over time. While surface water conditions are expected to improve over time, it is uncertain whether selenium concentrations will ultimately reduce below the water quality standard at all monitoring locations in Sage Creek and Crow Creek over the long term.

Installing a 5-foot Dinwoody or Salt Lake Formation/chert cover is estimated to reduce the infiltration of water for an average precipitation year by 29% (see Appendix A). This would lead to similar reduction of selenium releases at the target cover areas and would be expected to reduce selenium mass flux in Wells Formation groundwater and consequently the mass flux discharging at the spring complex over time.

Implementability – High

Construction of Dinwoody or Salt Lake Formation/chert covers would be technically feasible and would not require specialized construction techniques or special access logistics. Simplot has installed a similar cover at the Pole Canyon ODA.

As in Section 2.3.1.4 for Alternative WG-4, sufficient volumes of chert material are expected to be recovered from ongoing mining and multiple sources of Dinwoody or Salt Lake Formation material could be available, depending on active mining. Because of uncertainties with the volumes of material available from active mining, for the purposes of this report, it is assumed that the Sage Valley borrow area will provide Dinwoody or Salt Lake Formation material for the covers (Figure 2-8). This provides a consistent basis to evaluate the relative performance and cost in the comparative analysis (Section 4).

Placement of rock covers as a physical barrier layer on seeps and detention ponds to prevent direct contact with surface water with arsenic concentrations greater than the MCL has been previously implemented and would be easy to implement using readily available Site materials.

Cost – Moderate

The estimated capital cost for a 5-foot Dinwoody or Salt Lake Formation/chert cover on the target cover areas (194 acres) is $20 Million.

Screening Result

A 5-foot Dinwoody or Salt Lake Formation/chert cover would reduce infiltration of water into the ODA surface at the target cover areas (and subsequent release of selenium to Wells Formation groundwater and transport to surface water); however, it has a lower effectiveness than a capillary cover. This alternative is NOT RETAINED for the detailed analysis of alternatives.

2.3.2.3 Alternative SW-3 – Capillary Covers

Description

The cover element of this remedial alternative would be the same as for Alternative WG-5, described in Section 2.3.1.5 (Figures 2-7 and 2-9).

Rock covers on seeps (DS-7 and LP-1) and detention ponds (DP-7 and EP-2) would be the same as for Alternative SW-2.

Long-term surface water monitoring and O&M would be required to evaluate the effectiveness of the alternative.

Screening Evaluation

Effectiveness – Moderate to High

Human health would be protected through the use of fences and/or signs in the short term and ultimately rock covers to prevent ingestion of surface water in seeps and detention ponds with arsenic concentrations greater than the MCL.

Concentrations of selenium in surface water in Sage Creek and Crow Creek downstream of Hoopes Spring are anticipated to decrease over time. While surface water conditions are expected to improve over time, it is uncertain whether selenium concentrations will ultimately reduce below the water quality standard at all monitoring locations in Sage Creek and Crow Creek over the long term.

Installing a capillary cover is estimated to reduce the infiltration of water for an average precipitation year by 58% (see Appendix A). This would lead to similar reduction of selenium releases at the target cover areas and would be expected to reduce selenium mass flux in Wells Formation groundwater and consequently the mass flux discharging at the spring complex over time.

Implementability – High

Construction of capillary covers would be technically feasible and would not require specialized construction techniques or special access logistics. Simplot has installed covers using similar materials at the Smoky Canyon Mine.

As described in Section 2.3.1.5 for Alternative WG-5, sufficient volumes of chert material are expected to be recovered from ongoing mining and multiple sources of Dinwoody or Salt Lake Formation material could be available, depending on active mining. Because of uncertainties with the volumes of material available from active mining, for the purposes of this report, it is assumed that the Sage Valley borrow area will provide Dinwoody or Salt Lake Formation material for the covers. This provides a consistent basis to evaluate the relative performance and cost in the comparative analysis (Section 4).

Placement of rock covers as a physical barrier layer on seeps and detention ponds to prevent direct contact with surface water with arsenic concentrations greater than the MCL has been previously implemented and would be easy to implement using readily available Site materials.

Cost – Moderate

The estimated capital cost for a capillary cover on the target cover areas (194 acres) is $33 Million.

Screening Result

A capillary cover is implementable and would reduce infiltration of water into the ODA surface (and subsequent release of selenium to Wells Formation groundwater and migration to surface water via discharge at the spring complex) at a higher effectiveness than Alternative SW-2 (5-foot thick Dinwoody or Salt Lake Formation/chert covers). This alternative is RETAINED for the detailed analysis of alternatives.

2.3.2.4 Alternative SW-4 – Enhanced Dinwoody Covers

Description

The covers element of this alternative would be the same as for Alternative WG-6, described in Section 2.3.1.6 (Figure 2-7).

Rock covers on seeps (DS-7 and LP-1) and detention ponds (DP-7 and EP-2) would be the same as for Alternative SW-2.

Long-term surface water monitoring and O&M would be required to evaluate the effectiveness of the remedy.

Screening Evaluation

Effectiveness – Moderate to High

Human health would be protected through the use of fences and/or signs in the short term and ultimately rock covers to prevent ingestion of surface water in seeps and detention ponds with arsenic concentrations greater than the MCL.

Concentrations of selenium in surface water in Sage Creek and Crow Creek downstream of Hoopes Spring are anticipated to decrease over time. While surface water conditions are expected to improve over time, it is uncertain whether selenium concentrations will ultimately reduce below the water quality standard at all monitoring locations in Sage Creek and Crow Creek over the long term.

Installing an Enhanced Dinwoody cover is estimated to reduce the infiltration of water for an average precipitation year by up to 95% (see Appendix A). This would lead to similar reduction of selenium releases at the target cover areas and would be expected to reduce selenium mass flux in Wells Formation groundwater and consequently the mass flux discharging at the spring complex over time.

As discussed for Alternative WG-6 (Section 2.3.1.6), this model estimate is based on evaluation of the Enhanced Dinwoody covers installed at Panel F and likely overestimates the performance for a cover installed on existing overburden at the target cover areas. At Panel F the cover construction is integrated with placement of overburden generated by active mining.

Implementability – High

As discussed in Section 2.3.1.6 for Alternative WG-6, construction of Enhanced Dinwoody covers would be technically feasible and would not require specialized construction techniques or special access logistics. Simplot has installed Enhanced Dinwoody covers at Panel F for reclamation of active mining. As discussed in Section 2.3.1.6, it will be difficult to construct more than 30 to 35 acres in a given year at Smoky Canyon Mine, with the limited construction season. This will lead to several years of construction to complete the 194 acres.

Placement of rock covers as a physical barrier layer on seeps and detention ponds to prevent direct contact with surface water with arsenic concentrations greater than the MCL has been previously implemented and would be easy to implement using readily available Site materials.

Cost – High

The estimated capital cost for an Enhanced Dinwoody cover on target cover areas (194 acres) is $60 Million.

<u>Screening Result</u>

Enhanced Dinwoody covers have been shown to be effective at Panel F, where they are integrated with placement of overburden generated by active mining. The Enhanced Dinwoody cover performance is similar to geomembrane covers, which are retained for the detailed analysis. To avoid carrying forward too many similar options Enhanced Dinwoody covers are NOT RETAINED for the detailed analysis.

2.3.2.5 Alternative SW-5 – Geomembrane Covers

<u>Description</u>

The cover elements of this alternative would be the same as for Alternative WG-7, described in Section 2.3.1.7 (Figure 2-7).

Rock covers on seeps (DS-7 and LP-1) and detention ponds (DP-7 and EP-2) would be the same as for Alternative SW-2.

Long-term surface water monitoring and O&M would be required to evaluate the effectiveness of the remedy.

Screening Evaluation

Effectiveness – Moderate to High

Human health would be protected through the use of fences and/or signs in the short term and ultimately rock covers to prevent ingestion of surface water in seeps and detention ponds with arsenic concentrations greater than the MCL.

Concentrations of selenium in surface water in Sage Creek and Crow Creek downstream of Hoopes Spring are anticipated to decrease over time. While surface water conditions are expected to improve over time, it is uncertain whether selenium concentrations will ultimately reduce below the water quality standard at all monitoring locations in Sage Creek and Crow Creek over the long term.

Installing a geomembrane cover is estimated to reduce the infiltration of water for an average precipitation year by 100% in the short term (see Appendix A). This would lead to similar reduction of selenium releases at the target cover areas and would be expected to reduce selenium mass flux in Wells Formation groundwater and consequently the mass flux discharging at the spring complex over time. However, the geomembrane has a finite life expectancy because it is composed of man-made materials.

Implementability – Moderate to High

Placement of rock covers as a physical barrier layer on seeps and detention ponds to prevent direct contact with surface water with arsenic concentrations greater than the MCL has been previously implemented and would be easy to implement using readily available Site materials.

Geomembrane covers can be constructed using specialized construction techniques but can have constructability issues and long-term sustainability concerns.

Cost – High

The estimated capital cost for a geomembrane cover on the target cover areas (194 acres) is $74 Million.

Screening Result

Geomembrane covers are effective in reducing infiltration into the ODA surface in the short term, but the geomembrane has a finite life expectancy because it is composed of man-made materials. This alternative is RETAINED for the detailed analysis to provide an analysis of the type of cover that has the potential to provide the highest reduction in infiltration into overburden materials.

2.3.2.6 Alternative SW-6 –Treatment of Water Discharging at Hoopes Spring

Description

Alternative SW-6 consists of water treatment at Hoopes Spring and would use the existing Hoopes WTP, which was constructed in 2014 and modified in 2017 for a biological water treatment pilot study (Formation 2014b, 2017). Alternative SW-6 would entail continued operation of the existing pilot treatment system at approximately 2,000 gallons per minute (gpm) and could also include construction of a separate parallel WTP to treat an additional 1,000 gpm.

The existing Hoopes WTP consists of pumping stations located at Hoopes Spring and South Fork Sage Creek springs that pump spring water with elevated selenium concentrations to the Hoopes WTP. Treated water is discharged back to the main stem of Hoopes Spring via the riprap-lined outfall channel north of the treatment building. The treatment system uses two treatment trains, which consist of ultrafiltration (UF) to remove particulate material and reverse osmosis (RO) and fluidized bed bioreactors (FBRs) to remove selenium, at a maximum design flow rate of approximately 2,000 gpm. Polishing steps used in the existing treatment system include aeration, clarification, and sand filtration. The FBR effluent is treated using an activated sludge post-treatment system prior to discharge to the outfall. A third, parallel treatment train could be added to increase the maximum design flow rate to 3,000 gpm.

Rock covers on seeps (DS-7 and LP-1) and detention ponds (DP-7 and EP-2) would be the same as for Alternative SW-2.

Alternative SW-6 would require O&M of the UF/RO FBR treatment system. Long-term performance monitoring of the Hoopes WTP (i.e., influent, effluent, and UF backwash) would also be required.

Screening Evaluation

Effectiveness – High

Human health would be protected through the use of signs and/or fences in the short term and ultimately rock covers to prevent ingestion of surface water with arsenic concentrations above the MCL in seeps and detention ponds.

Selenium concentrations in surface water in the Sage/Crow Creek watershed downstream from Hoopes Spring and South Fork Sage Creek springs would be immediately reduced by treatment. The WTP system has removed approximately 40% of the total selenium mass flux emanating from Hoopes Spring and South Fork Sage Creek springs with a corresponding reduction in concentrations in surface water downstream in Sage Creek and Crow Creek. If the WTP were increased in total capacity from 2,000 to 3,000 gpm, the reduction in mass flux would be on the order of 60%.

Mass flux of selenium to surface water from discharge of Wells Formation groundwater is anticipated to decrease over time. This would cause a proportional reduction of selenium concentrations in downstream surface water in the future.

Implementability – High

Continued use of the Hoopes WTP, which consists of two FBR units with accompanying UF/RO systems, and possibly addition of a third FBR unit would be technically feasible. The FBRs generate a sludge that requires management and disposal. Construction of rock covers on seeps and detention ponds would be implementable. O&M and performance monitoring of the WTP would be implementable.

Cost – Moderate

The capital cost for the existing Hoopes WTP is $38 Million.

Screening Result

Water treatment has an immediate effect on selenium concentrations in the Sage Creek/Crow Creek watershed and is RETAINED for the detailed analysis.

2.3.3 Remedial Alternatives for Alluvial Groundwater

Releases of selenium and arsenic from overburden in the Pole Canyon ODA have resulted in MCL exceedances in groundwater in the alluvial groundwater system in lower Pole Canyon and downgradient in northern Sage Valley downstream of the confluence with Pole Canyon Creek (GW-26, GW-15, GW-22) (Figure 2-13). There is a potential risk to human receptors (hypothetical resident) if this groundwater is used for domestic drinking water supply from wells on Simplot-owned land in Sage Valley in the future.

RAOs for alluvial groundwater are:

- Prevent future use of alluvial groundwater with arsenic or selenium concentrations above MCLs as a drinking water source.
- Reduce or eliminate concentrations of arsenic and selenium in contaminated alluvial groundwater to below MCLs within a reasonable time frame given the circumstances of the Site.

Media-based remedial alternatives for alluvial groundwater were assembled by combining the retained remedial technologies and process options that are capable of addressing RAOs. The screening evaluation of these alternatives is presented in Table 2-4 and described below.

The remedial alternatives for alluvial groundwater are:

- Alternative AG-1 – No Further Action
- Alternative AG-2 – Monitored Natural Attenuation (MNA)
- Alternative AG-3 – Institutional Controls (ICs) and MNA
- Alternative AG-4 – Permeable Reactive Barrier (PRB), ICs and MNA

2.3.3.1 Alternative AG-1 – No Further Action

<u>Description</u>

No additional actions would be taken under Alternative AG-1.

<u>Screening Evaluation</u>

Effectiveness – Low

During the RI, arsenic concentrations were measured above the MCL in alluvial groundwater at GW-15 (located near the mouth of Pole Canyon: see Figure 2-14). Monitoring after 2014 has shown that concentrations are now below the MCL (Figure 2-15). The 2006 NTCRA at the Pole Canyon NTCRA (implemented in 2007 and 2008) significantly reduced the volume of water that was entering the ODA, particularly the inflow of Pole Canyon Creek, and consequently has reduced the mass of COCs released. This has had the effect of reducing arsenic concentrations to below the MCL in alluvial groundwater such that human health is protected for the No Further Action alternative (O&M of the Pole Canyon NTCRAs will continue as per the existing Settlement Agreements). Therefore, arsenic is not discussed further in this analysis for alluvial groundwater. No additional response actions would be implemented.

Human health would not be protected because groundwater with selenium concentrations above the MCL could be used as a source of drinking water on Simplot-owned land in Sage Valley in the future. There are no environmental risks associated with alluvial groundwater.

Mass transport of selenium in groundwater is anticipated to decrease over time as a result of the effect of NTCRAs. This would result in a reduction in selenium concentrations. However, it is uncertain whether selenium concentrations will ultimately reduce to below the MCL at all monitoring locations over the long term.

Implementability – High

No additional actions would be implemented. There are no implementability issues with this alternative.

Cost – Low

There are no additional response actions under Alternative AG-1 and therefore there is no cost.

Screening Result

No further action is RETAINED as required by the NCP.

2.3.3.2 Alternative AG-2 – Monitored Natural Attenuation (MNA)

Description

Alternative AG-2 consists of MNA to reduce contamination in alluvial groundwater. MNA relies on natural processes to contribute to the reduction of selenium concentrations in groundwater, as described for Alternative WG-2.

Long-term groundwater monitoring would be required to assess the progress of the natural attenuation in alluvial groundwater.

Screening Evaluation

Effectiveness – Low

Human health would not be protected because groundwater with selenium concentrations above the MCL could be used as a source of drinking water in the future. There are no environmental risks associated with alluvial groundwater. The same reduction of selenium concentrations in alluvial groundwater would occur over time as Alternative AG-1.

As discussed in Section 2.3.1.2, Hay et al. (2016) evaluated the release and subsequent transport of selenium leached from overburden at multiple phosphate mines in southeastern Idaho, with a particular emphasis on understanding conditions leading to selenium attenuation. They found that comparing the ratio of selenium to sulfate, as well as the concentration of redox sensitive parameters (dissolved oxygen, dissolved iron, dissolved manganese) in groundwater samples to those of saturated and unsaturated column tests were valuable in understanding selenium release and attenuation.

The concentrations of total selenium, sulfate, dissolved iron, dissolved manganese, and dissolved oxygen from select wells, springs and seeps are summarized in Table 2-6. The ratio of total selenium to sulfate for alluvial groundwater is shown on Figure 2-16. For comparison, the upper and lower bounds of the unsaturated column tests as reported by Hay et al. (2016) are also presented. As shown, the ratio of selenium to sulfate in alluvial groundwater is generally consistent with the unsaturated column tests, (ratios occur within the upper and lower bounds of the unsaturated column tests) indicating that, with the exception of dispersion and dilution, limited natural attenuation of selenium is occurring in the alluvial groundwater. Relatively high dissolved oxygen and low concentrations of dissolved iron and manganese also suggest oxic conditions with limited natural attenuation due to reductive precipitation. The mass balance model indicates some attenuation of selenium; however, the attenuation in alluvial groundwater may be occurring farther downgradient in the organic-rich alluvial deposits along North Fork Sage Creek in Sage Valley where the groundwater is very near the surface.

Implementability – High

No remedial construction or maintenance would be required and MNA would be easy to implement. Long-term monitoring of MNA would be technically and administratively feasible.

Cost – Low

There are no capital costs for MNA.

Screening Result

It appears that the geochemical attenuation mechanism does not currently limit the extent of selenium transport from the Pole Canyon ODA, and natural attenuation may offer only limited reductions in selenium concentrations in downgradient alluvial groundwater. However, conditions in waste rock within ODAs are variable and may become less oxic over time, which could affect conditions in alluvial groundwater. Therefore, natural attenuation may be effective and may result in a reduction of selenium concentrations over time. MNA is RETAINED in conjunction with other remedial alternatives (i.e., source control already performed under the NTCRAs) for the detailed analysis.

2.3.3.3 Alternative AG-3 – Institutional Controls (ICs) and MNA

Description

Alternative AG-3 would entail deed restrictions on Simplot-owned land in Sage Valley to prevent the use of alluvial groundwater with selenium concentrations above MCLs as a domestic water supply. Deed restrictions would only be applied to areas where selenium concentrations exceed the MCL and would ultimately be removed when the MCL is met throughout Simplot-owned land in Sage Valley. ICs would require preparation of an ICIAP to establish and document the activities necessary to implement and ensure the long-term stewardship of ICs; and specify the organization responsible for conducting these activities. The ICIAP would focus on the details of how the deed restrictions would be implemented, maintained, enforced, modified, and terminated (if applicable). MNA would be the same as described under Alternative AG-2.

Screening Evaluation

Effectiveness – Moderate to High

Deed restrictions on Simplot land in Sage Valley would prevent the use of alluvial groundwater with selenium concentrations above the MCL as a source of drinking water and protect human health. There are no environmental risks associated with alluvial groundwater. The same reduction of selenium concentrations would occur over time as Alternative AG-1.

Implementability – High

Implementation of ICs would be technically and administratively feasible. MNA would be evaluated by long-term groundwater monitoring.

Cost – Low

The estimated capital cost for ICs is $50,000.

Screening Result

This alternative would provide immediate protection of human health and is RETAINED for the detailed analysis.

2.3.3.4 Alternative AG-4 – Permeable Reactive Barrier, ICs and MNA

Description

Alternative AG-4 consists of a subsurface PRB to treat water from the LP-1 seep.

The PRB technology is an in-situ permeable system that uses reactive media designed to passively treat intercepted contaminated groundwater. The type of reactive material selected for the PRB depends on local hydrogeologic conditions and types of contaminants in the groundwater. Once selected, the reactive media is placed in a trench and water is flowed through to be treated. Chemical reactions between the reactive media and contaminated groundwater flowing through the media result in transformation or immobilization of the contaminants.

The PRB would consist of a trench excavated downgradient of the ODA where no overburden is present in the Pole Canyon Creek channel and aligned perpendicular to flow to intercept Pole Canyon ODA toe seep water at LP-1 with the bottom and sides of the trench keyed into bedrock. The PRB would be filled with structural backfill (e.g., silica sand), a short-term carbon source (e.g., alfalfa hay or grass hay), and a long-term carbon source (e.g., wood chips) to passively treat contaminated seep water and alluvial groundwater using biodegradation. The reactive media would use chemical and microbial processes to chemically reduce and transform selenium from selenate to selenite and ultimately to elemental selenium.

ICs under Alternative AG-4 would entail deed restrictions on Simplot-owned land in Sage Valley to prevent the use of shallow alluvial groundwater with selenium concentrations above the MCL as a domestic water supply. MNA would be the same as described under Alternative AG-2. O&M and long-term groundwater monitoring would be required to evaluate the performance and effectiveness of the remedy.

Screening Evaluation

Effectiveness – High

ICs (deed restrictions) would prevent the use of alluvial groundwater with selenium concentrations above the MCL as a source of drinking water. There are no environmental risks associated with alluvial groundwater.

Mass transport of selenium in alluvial groundwater is anticipated to decrease over time as the effect of releases during active mining diminishes and because of the effect of subsequent reclamation/NTCRA actions. This would result in a reduction in selenium concentrations. The PRB would have an immediate effect on reducing selenium concentrations in downgradient alluvial groundwater.

Implementability – High

Installation, O&M, and long-term monitoring of the PRB would be technically and administratively feasible. The PRB would be constructed of appropriate reactive media, would have a hydraulic conductivity similar to nearby alluvium/bedrock, and seep inflow would have a retention time adequate to treat selenium. A similar PRB has been constructed at the Conda/Woodall Mountain ("Conda") Mine. MNA would be evaluated by long-term groundwater monitoring.

Cost – High

The estimated capital cost for constructing a PRB is $444,000.

Screening Result

A PRB would immediately reduce selenium concentrations in downgradient alluvial groundwater. This alternative is RETAINED for the detailed analysis.

2.3.4 Remedial Alternatives for Solids and Soils

There are potential future and current risks to human receptors (seasonal rancher) from ingestion of beef as the primary contributor of cancer risk, due to arsenic concentrations in soil with the highest concentrations in Panel A Area 2, detention pond AP-3 (adjacent to west end of Pole Canyon ODA), Panel D seep DS-7 area, detention pond DP-7, and detention pond EP-4 (Figure 2-17).

There is a potential risk to terrestrial biota from soil/overburden and biotic media (vegetation, invertebrates, and small mammals) with elevated selenium concentrations in overburden on backfilled pits and external ODAs with minimal or no covers in the Panel A Area 2 (south of mill) and Panel D areas, and from soils in overburden seep/riparian areas downgradient of (or below) Panel D (DS-7), Panel E (ES-4), and the Pole Canyon ODA (LP-1) (Figure 2-17).

The RAOs for solids and soils are:

- Reduce or eliminate unacceptable risks to future seasonal ranchers from ingestion of beef from livestock grazing on ODAs as the primary contributor of cancer risk, due to arsenic concentrations (calculated on a Site-wide basis) for soil.
- Reduce or eliminate unacceptable risks to terrestrial biota from soil with elevated selenium concentrations on overburden or backfilled pits and external ODAs with minimal or no covers and in overburden seep/riparian areas downgradient of ODAs.

Remedial alternatives for solids and soils were assembled by combining the retained remedial technologies and process options that are capable of addressing RAOs. The screening evaluation of these alternatives is presented in Table 2-5 and described below.

The remedial alternatives for solids and soils are:

- Alternative S-1 – No Further Action
- Alternative S-2 – Rock Covers on Soils in Seep and Riparian Areas
- Alternative S-3 – 2-Foot Dinwoody or Salt Lake Formation Covers on Uncovered Areas of ODAs and Rock Covers on Soils in Seep and Riparian Areas
- Alternative S-4 – 5-Foot Dinwoody or Salt Lake Formation/Chert Covers on Uncovered Areas of ODAs and Rock Covers on Soils in Seep and Riparian Areas

2.3.4.1 Alternative S-1 – No Further Action

Description

No additional actions would be taken under Alternative S-1.

Screening Evaluation

Effectiveness – Moderate

The Site has approximately 1,060 acres of covered overburden either by post-mining reclamation (Panels C and E, areas of Panels A and D, and the areas at Panel B where mining has been completed) or by NTCRA (Pole Canyon ODA). Uncovered areas of Panels A and D (Figure 2-18) comprise approximately 360 acres.

No additional response actions would be implemented to cover additional ODA areas and residual risks would not change.

Implementability – High

No additional actions would be implemented. There are no implementability issues with this alternative.

Cost – Low

There are no additional response actions under Alternative S-1 and therefore there is no cost.

Screening Result

No further action is RETAINED as required by the NCP.

2.3.4.2 Alternative S-2 – Rock Covers on Soils in Seep and Riparian Areas

Description

Under Alternative S-2, rock covers would be placed as a physical barrier layer on soils in overburden seep and riparian areas (DS-7, ES-4, and LP-1) and detention ponds (AP-3, DP-7, and EP-4) below ODAs to prevent terrestrial biota from contacting or ingesting soil with elevated selenium concentrations.

Screening Evaluation

Effectiveness – Moderate to High

Rock covers would be effective in preventing contact with and ingestion of soil with elevated arsenic and selenium concentrations in seep and riparian areas and detention ponds below ODAs. Residual risks would remain for terrestrial biota with access to uncovered ODAs.

Implementability – High

Installing rock covers would be easy to implement.

Cost – Low

The estimated capital costs for installation of rock covers on soil in overburden seep and riparian areas and detention ponds below ODAs would be $22,400.

Screening Result

Alternative S-2 would prevent access to soil in detention ponds and seep and riparian areas and detention ponds below ODAs and is RETAINED for the detailed analysis of alternatives.

2.3.4.3 Alternative S-3 – 2-Foot Dinwoody or Salt Lake Formation Covers on Uncovered Areas of ODAs and Rock Covers on Soils in Seep and Riparian Areas

Description

Under this alternative, 2-foot Dinwoody or Salt Lake Formation covers would be constructed on all uncovered areas of Panels A and D (Figure 2-18). Storm water run-on and runoff controls would be constructed, and the cover would be vegetated with native grass/forb species to control erosion.

In addition, rock covers would be placed as a physical barrier layer on soils in overburden seep and riparian areas (DS-7, ES-4, and LP-1) and detention ponds (AP-3, DP-7, and EP-4) below ODAs to prevent terrestrial biota from contacting or ingesting soil with elevated selenium concentrations. These actions would be the same as described under Alternative S-2.

ICs under Alternative S-3 would include grazing controls, land-use controls, and information programs. Grazing controls and land-use controls would be implemented by the Forest Service as needed to restrict access to cover areas while the cover vegetation matures. Information programs would be used for public lands to restrict activities that could compromise the cover and to notify people that covered contamination remains at the Site.

Inspections would be conducted to monitor settlement and erosion of the cover system, vegetative growth, and integrity of the storm water control systems. O&M would be required to maintain the effectiveness and permanence of the covers and components of erosion controls.

Screening Evaluation

Effectiveness – High

The Site has approximately 1,060 acres of covered overburden either by post-mining reclamation (Panels C and E, areas of Panels A and D, and the areas at Panel B where mining has been completed and a cover installed) or by NTCRA (Pole Canyon ODA). The uncovered areas of Panels A and D comprise approximately 360 acres. Covering the uncovered areas at Panel A and Panel D would eliminate all areas of exposed overburden at the Site. Rock covers would cover soils in overburden seep and riparian areas and detention ponds below ODAs where terrestrial biota could be exposed to selenium in soil.

Implementability – High

Construction of Dinwoody or Salt Lake Formation covers would be technically feasible and would not require specialized construction techniques or special access logistics. Dinwoody Formation material has been used to construct covers throughout the Site. A 2-foot-thick cover over 360 acres would require approximately 1.2 million cubic yards of material. As discussed in Section 2.3.1.4, there is the potential that active mining at Panels F and G could generate excess Dinwoody Formation material that could be used for CERCLA covers. Another potential option is to source Dinwoody or Salt Lake Formation material from Simplot's private land in Sage Valley (Figure 2-8). All efforts will be made to source Dinwoody material from active mining, however, there is too much uncertainty to make that determination at this time. Therefore, for the purposes of this report, it is assumed that the Sage Valley borrow area will provide Dinwoody or Salt Lake Formation material for the covers. This provides a consistent basis to evaluate the relative performance and cost in the comparative analysis (Section 4).

Rock covers would be easily implementable. Implementation of ICs to restrict access to cover areas while the cover vegetation matures would be technically feasible.

Cost – Moderate

The estimated capital cost for a 2-foot Dinwoody or Salt Lake Formation cover on all uncovered areas of Panels A and D (360 acres) is $18 Million.

<u>Screening Result</u>

Alternative S-3 would eliminate all areas of uncovered overburden at the Site and is RETAINED for the detailed analysis.

2.3.4.4 Alternative S-4 – 5-Foot Dinwoody or Salt Lake Formation/Chert Covers on Uncovered Areas of ODAs and Rock Covers on Soils in Seep and Riparian Areas

<u>Description</u>

The same areas would be covered as described under Alternative S-3. Under this alternative, the covers would be 5-foot Dinwoody or Salt Lake Formation/chert covers with associated storm water controls.

As for Alternative S-3, rock covers would be placed as a physical barrier layer on soils in overburden seep and riparian areas (DS-7, ES-4, and LP-1) and detention ponds (AP-3, DP-7, and EP-4) below ODAs.

The same ICs, inspections, and O&M would be implemented as described for Alternative S-3.

<u>Screening Evaluation</u>

Effectiveness – High

The Site has approximately 1,060 acres of covered overburden either by post-mining reclamation (Panels C and E, areas of Panels A and D, and the areas of Panel B where mining has been completed and a cover installed) or by NTCRA (Pole Canyon ODA). The uncovered areas of Panels A and D comprise approximately 360 acres. Covering the uncovered areas at Panel A and Panel D would eliminate all areas of exposed overburden at the Site.

The rock covers would cover soils in overburden seep and riparian areas and detention ponds below ODAs where terrestrial biota could be exposed to selenium in soil.

Implementability – High

Construction of Dinwoody or Salt Lake Formation/chert covers would be technically feasible and would not require specialized construction techniques or special access logistics. The same cover has been installed at the Pole Canyon ODA. To construct the cover over 360 acres would require approximately 1.7 million cubic yards of Dinwoody or Salt Lake Formation and 1.2 million cubic yards of chert. Sufficient volumes of chert material are expected to be recovered from ongoing mining; however, this may require a phased approach to cover construction to allow the required volume of chert to be generated. The estimated recoverable volume of good clay material from the B-Panel Dinwoody borrow areas was less than approximately 3 million cubic yards. There is also the potential that active mining at Panels F and G could generate excess Dinwoody material that could be used for CERCLA covers. Another potential option is to source Dinwoody or Salt Lake Formation material from Simplot's private land in Sage Valley (Figure 2-8). All efforts will be made to source Dinwoody from active mining; however, there is too much uncertainty to make that determination at this time. Therefore, for the purposes of this report, it is assumed that the Sage Valley borrow area will provide Dinwoody or Salt Lake material for the covers.

Rock covers would be easily implementable. Implementation of ICs to restrict access to cover areas while the cover vegetation matures would be technically feasible.

Cost – High

The estimated capital costs for a 5-foot Dinwoody or Salt Lake Formation/chert cover on all uncovered areas of Panel A and Panel D (360 acres) is $33 Million.

Screening Result

Alternative S-4 would provide the same level of effectiveness as Alternative S-3. The thicker cover would not provide additional protection. It has a significantly higher cost and is therefore NOT RETAINED.

2.4 Alternatives Retained for the Detailed Analysis

The media-based remedial alternatives retained for the detailed analysis are:

- Wells Formation Groundwater Remedial Alternatives
    - Alternative WG-1 – No Further Action
    - Alternative WG-3 – Institutional Controls (ICs)
    - Alternative WG-5 – Capillary Covers, ICs and MNA
    - Alternative WG-7 – Geomembrane Covers, ICs and MNA

- Surface Water Remedial Alternatives
    - Alternative SW-1 – No Further Action
    - Alternative SW-3 – Capillary Covers
    - Alternative SW-5 – Geomembrane Covers
    - Alternative SW-6 – Treatment of Water Discharging at Hoopes Spring

- Alluvial Groundwater Remedial Alternatives
    - Alternative AG-1 – No Further Action
    - Alternative AG-3 – Institutional Controls (ICs) and MNA
    - Alternative AG-4 – Permeable Reactive Barrier, ICs and MNA

- Solids and Soils Remedial Alternatives
    - Alternative S-1 – No Further Action
    - Alternative S-2 – Rock Covers on Soils in Seep and Riparian Areas
    - Alternative S-3 – 2-Foot-Thick Dinwoody or Salt Lake Formation Covers on Uncovered Areas of ODAs and Rock Covers on Soils in Seep and Riparian Areas

3.0 DETAILED ANALYSIS OF ALTERNATIVES

As described in USEPA guidance for RI/FS (USEPA 1988), the detailed analysis provides the means by which facts are assembled and evaluated to develop the rationale for a remedy selection. The detailed analysis of remedial alternatives consists of the following components:

- Further definition of each alternative, if necessary, with respect to the volumes or areas of contaminated media to be addressed, the technologies to be used, and any performance measurements associated with those technologies.
- An assessment of each alternative against the evaluation criteria.

The evaluations conducted during the detailed analysis build on previous evaluations conducted during the development and screening of alternatives. This phase also incorporates the treatability study data collected at the Hoopes WTP as part of the RI/FS process (Formation 2017).

3.1 CERCLA Evaluation Criteria

Nine evaluation criteria have been developed to address CERCLA requirements. These criteria enable the analysis of each alternative to address the statutory requirements and considerations and the technical and policy considerations important for selecting among remedial alternatives and serve as the basis for conducting the detailed analysis of alternatives. The evaluation criteria have been divided into three groups based on the function of the criteria in selection of a remedy and include threshold criteria, balancing criteria, and modifying criteria.

3.1.1 Threshold Criteria

The threshold criteria relate to statutory requirements that each alternative must satisfy to be eligible for selection.

<u>Overall Protection of Human Health and the Environment</u> – The assessment against overall protection of human health and the environment describes how the alternative achieves and maintains protection of human health and the environment. This criterion draws on the assessment of long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

<u>Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)</u> – The assessment describes how the alternative meets Federal and State ARARs, or if a waiver is required and how it is justified. Other information from advisories, criteria, or guidance that the Agencies have agreed is “to be considered” (TBC) is also addressed in this assessment. The actual determination of which requirements are applicable or relevant and appropriate is made by

the Forest Service in consultation with the support agencies. Chemical-specific, location-specific, and action-specific ARARs and TBCs for the Smoky Canyon Mine were presented in FSTM#1 (refer to Tables 3-1 and 3-2, Formation 2019c).

3.1.2 Balancing Criteria

The balancing criteria are the technical criteria upon which the detailed analysis is primarily based.

Long-Term Effectiveness and Permanence – The assessment of alternatives against this criterion evaluates the long-term effectiveness of alternatives in maintaining protection of human health and the environment after RAOs have been met.

Reduction of Toxicity, Mobility, and Volume – The assessment of this criterion evaluates the anticipated performance of the specific treatment technologies that are used in the alternative.

Short-Term Effectiveness – The assessment of alternatives against this criterion examines the effectiveness of alternatives in protecting human health and the environment during the construction and implementation of a remedy until RAOs have been met.

Implementability – This assessment evaluates the technical and administrative feasibility of alternatives and the availability of required goods and services.

Cost – This assessment evaluates the capital and O&M costs of each alternative.

The level of detail required to analyze each alternative against these criteria depends on the complexity of the site, the types of technologies and alternatives being considered, and other project-specific considerations. The analysis conducted is of sufficient detail so that the decisionmakers understand the significant aspects of each alternative and any uncertainties associated with the evaluation.

3.1.3 Modifying Criteria

The modifying criteria are State and Tribal acceptance and community acceptance, and are assessed formally after the public comment period, although they are factored into the identification of the preferred alternative to the extent they are known.

State and Tribal Acceptance – This assessment evaluates the technical and administrative issues and concerns the State of Idaho and Shoshone-Bannock Tribes may have regarding each of the alternatives. This criterion will be addressed in the ROD once comments on the FS Report and Proposed Plan have been received.

Community Acceptance – This assessment evaluates the issues and concerns the public may have regarding each of the alternatives. As with State and Tribal acceptance, this criterion will be addressed in the ROD once comments on the FS Report and Proposed Plan have been received.

3.2 Individual Analysis of Alternatives

This section describes the detailed analysis of alternatives for each environmental medium. Alternatives retained after the initial screening were better defined, as needed, in order to apply the evaluation criteria consistently and to develop appropriate cost estimates. The seven evaluation criteria (threshold and balancing) encompass statutory requirements and technical, cost, and institutional considerations appropriate for a thorough evaluation. The detailed analysis of alternatives for each medium is provided in Tables 3-1 through 3-4.

Section 121 of CERCLA requires that remedies where waste is left on site that do not allow for unlimited use and unrestricted exposure be reviewed every five years (USEPA 2003). The purpose of the 5-year review is to evaluate the implementation and performance of the remedy to determine whether the remedy is protective of human health and the environment. The Forest Service, as lead agency, would have primary responsibility for conducting the 5-year review, and the support agencies would provide concurrence on the findings.

3.2.1 Wells Formation Groundwater Remedial Alternatives

Three remedial alternatives for Wells Formation groundwater that are best capable of addressing the RAOs were retained and are further evaluated. The remedial alternatives evaluated for Wells Formation groundwater are:

- Alternative WG-1 – No Further Action
- Alternative WG-3 – Institutional Controls (ICs)
- Alternative WG-5 – Capillary Covers, ICs and MNA
- Alternative WG-7 – Geomembrane Covers, ICs and MNA

The complete detailed analysis of remedial alternatives for Wells Formation groundwater is provided in Table 3-1. The text below provides a summary of the key considerations.

3.2.1.1 Alternative WG-1 – No Further Action

Description

No additional actions would be taken under Alternative WG-1. O&M and groundwater/surface water monitoring for the NTCRAs at the Pole Canyon ODA would continue as per the existing Settlement Agreements (USFS, USEPA, and IDEQ 2006; USFS, IDEQ, and Tribes 2013).

The rate of selenium release after mining depends on location specific conditions; primarily the setting, areal extent of the overburden and the cover placed on it. The relative magnitude of selenium loading from the sources to Wells Formation groundwater is proportional to net infiltration rates through covers. Figure 3-1 shows the range of cover types placed on the backfilled pits and external ODAs during reclamation. In addition to the covers, Simplot has completed a large amount of work that has reduced release of selenium from overburden to Wells Formation groundwater. Appendix H of the Final RI Report (Formation 2014a) described the mining and reclamation activities that Simplot accomplished at the Site from 1983 through 2012. Additional reclamation activities that have been performed since then are briefly summarized below.

Panel A

- Run-on control ditch constructed at areas A-4 and A-3 (August 2014). Ditch diverts surface water off backfill areas to infiltration basin.

- Run-on control channel constructed at A-Pit and A-3 (August 2014). Ditch diverts surface water off backfill areas to infiltration basin.

- Sediment retention pond lined with high-density polyethylene (HDPE) (September 2017). Pond eliminates seasonal loading and associated groundwater impacts in the Industrial Well area. Pond water pumped to tailings impoundments.

Pole Canyon Haul Road Infiltration

- Run-off control channel along haul road constructed at A-2 (August 2015). Directs surface water under haul road to the infiltration basin, eliminating run-on to Pole ODA.

Panel C

- Run-on control ditches at Panel C (October 2013). HDPE-lined ditch at C-Panel north conveys water from C-Panel spring to Smoky Creek eliminating run-on water to the reclaimed pit backfill. Perforated pipe at C-Panel south captures flow at southern springs and flows to a clay-lined ditch that controls storm water run-on to the reclaimed pit backfill and diverts it onto the ground west of Panel C.

Panel D

- Two run-on control infiltration ponds constructed at Dinwoody Borrow area (July 2015).
- Upland run-on control channel constructed at Dinwoody Borrow area (July 2015). Channel directs upland run-on away from overburden to infiltration ponds.
- Storm water basin constructed at D-ODA (September 2015). Run-off from D-1 and D-ODA directed to lined basin. Overflow runs in ditch under haul road to infiltration basin.

Panel E

- Run-off control ditch constructed at pit E-1n (July 2017). Ditch diverts runoff from E-1 and E-1n off backfill areas.
- Run-off control ditch constructed at pit E-1n (September 2017). Ditch diverts run-on and runoff from E-1n backfill area under the haul road to sediment basin.

In addition, Simplot implemented two NTCRAs at the Pole Canyon ODA under CERCLA.

2006 Pole Canyon Water Management NTCRA

- Bypass pipeline (February 2007). Pipeline conveys diverted Pole Canyon Creek flow around Pole Canyon ODA on south side.
- Infiltration basin (October 2007). Basin directs upstream Pole Canyon Creek flow, between bypass pipeline inlet and ODA, along with creek flows in excess of pipeline capacity, into Wells Formation aquifer on upstream side of ODA.
- Run-on control channel adjacent to northern edge of ODA (November 2008). Channel directs run-on from adjacent slopes into Pole Canyon Creek downstream of ODA.

2013 Dinwoody/Chert Cover NTCRA

- 5-Foot Dinwoody/Chert Cover System (December 2015). Cover consists of a 3-foot-thick layer of fine-to-medium grained Dinwoody material overlying a 2-foot-thick gravel chert layer and revegetated with native non-selenium-accumulating species to control erosion and facilitate evapotranspiration. Cover system designed to reduce or eliminate the amount of water that infiltrates into ODA due to direct precipitation, reduce or eliminate potential for ecological risk due to ingestion of vegetation on ODA, and reduce or eliminate potential for risk to human receptors due to ingestion of vegetation and ingestion of and direct contact with ODA materials.

- Storm water Run-on/Runoff Controls (December 2015). Ditches, channels, chutes, berms, swales, culverts, and associated energy dissipation structures (EDS) that capture and collect flows from adjacent, topographically higher areas and convey flows around Pole Canyon ODA. Captured runoff from ODA is conveyed to one of several sedimentation basins. Storm water run-on/runoff controls designed to eliminate release of contaminants from ODA via sediment transport.

Assessment

Selenium concentrations in Wells Formation groundwater are above MCLs downgradient of source areas. For example, Figure 3-2 shows concentrations at monitoring well GW-25, which is downgradient of Panel E. As shown, selenium concentrations increased abruptly in 2011. This arrival is consistent with the timing of active mining at Panel E, the estimated groundwater flow velocity, and the distance to the well from the mining area (see Formation 2014a, Appendix H Figure 5-23). Since 2011, concentrations at GW-25 have generally exhibited a seasonal variation with a decreasing magnitude. For example, the maximum and minimum concentrations during the 2011 period were 0.594 mg/L and 0.296 mg/L, respectively; the maximum and minimum concentrations during the 2019 period were 0.331 mg/Land 0.277 mg/L, respectively. A linear regression, calculated with the 2011 through 2019 monitoring data, illustrates a decreasing trend of approximately 0.1 mg/L per 10-year period.

As shown in Figure 3-2, the concentrations at GW-25 also exhibit general correlation to a seasonal rise in the water table; years 2015 and 2016 are exceptions. The rising water table appears concomitant with high South Fork Sage Creek flows. The creek upstream of the South Fork Sage Creek springs area is a losing reach which only flows in spring. Surface water recharges the Upper Wells Formation during high flow periods, resulting in the seasonal water table fluctuations in the vicinity of GW-25. Surface water seasonally recharging the Upper Wells Formation in this area could account for some variation in concentrations at GW-25.

Figure 3-3 shows selenium concentrations downgradient of the Pole Canyon ODA (Well GW-16). Well GW-16 was installed in 2003. Pole Canyon Creek flowed through the ODA until the bypass pipeline was completed in 2007. The data show variable concentrations prior to the completion of the bypass pipeline, possibly as a result of the effect of Pole Canyon Creek flowing through the ODA. Following completion of the bypass pipeline, concentrations stabilized at around 0.8 mg/L from 2009 to early 2016 and have subsequently declined (currently in the range of 0.48 mg/L). This reducing trend in concentration is attributed to the installation of the cover on the ODA and associated storm water controls as part of the 2013 NTCRA, which was substantially completed in 2015. Since 2016, concentrations in GW-16 have reduced approximately 40% (0.48 mg/L / 0.8 mg/L). This reduction is, in part, the result of reduced loading from the ODA of approximately 30% (see Section 3.2.2.1) and dilution associated with runoff from cover areas to sedimentation basins (see Figure 2-2). As a comparison, concentrations at GW-26 (see Figure 2-13) showed an immediate reduction following the 2013 NTCRA. GW-26 is screened in the alluvium and is adjacent to the East sedimentation basin, which is designed to infiltrate storm water runoff into alluvium.

The Groundwater Model simulation indicates that mass flux of selenium from the ODAs to Wells Formation groundwater will reduce over time. Reduction is dependent on four primary factors: (1) the reduction of load that originated from active mining; (2) the effect of post-mining reclamation (i.e., covers) and other water controls implemented by Simplot; (3) the reduction of load from the Pole Canyon ODA as a result of the NTCRAs; and (4) the depletion of the selenium source term for the ODAs over time. These factors are described in detail in Section 3.2.2.1.

As the mass flux of selenium in Wells Formation groundwater decreases it is expected to result in a general reduction in selenium concentrations in groundwater, with specific effects being dependent on the physical location of the well screen relative to source areas and groundwater flow paths dictated by stratigraphic and structural conditions. Reductions in selenium concentrations in Wells Formation groundwater are anticipated to occur over the next 10 to 20 years as a result of the migration of selenium associated with active mining and the effects of the Pole Canyon NTCRAs and over the next 50 to 100 years as a result of the source depletion. While groundwater conditions are expected to improve over time, it is uncertain whether selenium concentrations will ultimately reduce to below the MCL at all monitoring locations.

For example, the selenium concentrations at GW-25 downgradient of Panel E were evaluated with a simple groundwater mixing analysis (see Appendix A). The analysis assumes an average aquifer flux (average aquifer parameters and gradient) mixed with a mass load from percolation through overburden, with an approximated source depletion rate. The resulting estimated groundwater concentrations are comparable to GW-25 observations as shown in Figure 3-2. The simulated source term depletion results in decreasing groundwater concentrations over the long term.

3.2.1.2 Alternative WG-3 – Institutional Controls (ICs)

<u>Description</u>

Under Alternative WG-3, ICs (deed restrictions) would be put in place to prevent the use of Wells Formation groundwater with selenium concentrations greater than the MCL as a source of drinking water on Simplot’s land in Sage Valley. Specific performance objectives (e.g., prevent access or use of Wells Formation groundwater until cleanup levels are met) would be included in the ROD and then specified as restrictions on the property deed. This alternative would require an ICIAP to specify how the deed restrictions will be implemented, maintained, enforced, modified, and terminated (if applicable). Deed restrictions would only be applied to areas where selenium concentrations exceed the MCL and would be ultimately be removed when the MCL is met throughout Simplot-owned land in Sage Valley.

Assessment

Deed restrictions on Simplot's land in Sage Valley to prevent use of groundwater with selenium concentrations above the MCL as a domestic water supply would protect human health. There are no environmental risks associated directly with Wells Formation groundwater.

The same reduction of selenium concentrations would occur over time for Alternative WG-3 as for Alternative WG-1, described above.

3.2.1.3 Alternative WG-5 – Capillary Covers, ICs and MNA

Description

Alternative WG-5 would include construction of a capillary cover on the target cover areas as shown on Figure 2-1. The capillary cover would consist of 2-feet of uncompacted Dinwoody or Salt Lake Formation material, a layer of filter fabric and 12-inches of screened chert/limestone over a working base layer of graded Dinwoody or Salt Lake Formation on top of graded overburden (Figure 2-9). It would also include drainage benches to remove water off the cover at spacings of approximately 150 feet (dependent on slope; closer spacing for flatter slopes) (refer to Section 2.3.1.5 for more details). ICs under Alternative WG-5 would be the same as under Alternative WG-3. Monitoring and O&M would be performed on the covers to verify their integrity. Long-term groundwater monitoring would be required to evaluate the effectiveness of the covers and MNA.

Assessment

Alternative WG-5 would have the same effectiveness for protection of human health as Alternative WG-3 due to the implementation of ICs to prevent use of Wells Formation groundwater with selenium concentrations above the MCL as drinking water. There are no environmental risks associated directly with Wells Formation groundwater.

Inclined covers with capillary barrier effect (CCBE) is an alternative to a conventional soil cover design. A conventional design often features a compacted, low permeability, soil layer, the efficacy of which can degrade due to drying and wetting processes as well as root and animal intrusion. The CCBE concept has been developed based on lysimeter observations from the Simple 1 cover at the Blackfoot Bridge mine (Benson 2019). The Simple 1 cover lysimeter has observed 21 to 43% of measured precipitation as interflow for years 2016–2019. The interflow component of the Simple 1 cover is attributed to capillary barrier effects.

The capillary barrier effect is created when a fine textured soil (moisture retention layer, MRL) is placed over a coarse textured material (i.e., capillary break layer, CBL). The textural contrast between the MRL and CBL controls vertical infiltration through the cover by capillary forces. Water infiltrating into the MRL on an inclined capillary barrier cover accumulates downslope in the MRL. Drainage benches placed along the slope divert infiltrating water from the MRL prior to transmission to the CBL, which would otherwise result in percolation into the underlying seleniferous overburden. The spacing of the drainage benches is dependent of the slope: more shallow steep slopes require closer benches. Overburden grading or addition of fill material (Dinwoody, Salt Lake Formation or chert) will be required to produce the continuous slopes required for effective performance. Uncompacted Dinwoody (the MRL) over screened chert (the CBL) are proposed materials for use in the CCBE. Appendix A discusses the proposed CCBE in more detail.

A preliminary estimate of the reduction of infiltration of water for an average precipitation year is 58% (see Appendix A). This would lead to a similar reduction of selenium releases at the target cover areas and would be expected to reduce selenium concentrations in Wells Formation groundwater in the vicinity in addition to reductions predicted to occur without additional action (see Section 3.2.1.1). This is a relatively new cover concept that would require analysis during remedial design to assess the effectiveness of the components relative to specific material properties and conditions at the Site.

3.2.1.4 Alternative WG-7 – Geomembrane Covers, ICs and MNA

Description

Alternative WG-7 would include construction of geomembrane covers on the target cover areas and associated storm water controls. The geomembrane covers would conceptually consist of multiple layers to reduce infiltration into the overburden material, including a geomembrane (Figure 2-7). This layer would be protected and supported by layers of local materials. For example, the cover could include a 1-foot-thick protective subgrade that would be placed on the overburden material to prevent damage to the geomembrane layer and 3 feet of Dinwoody/topsoil on top of the hydraulic barrier layer.

Assessment

Alternative WG-5 would have the same effectiveness for protection of human health as Alternative WG-3 due to the implementation of ICs to prevent use of Wells Formation groundwater with selenium concentrations above the MCL as drinking water. There are no environmental risks associated directly with Wells Formation groundwater.

Installing a geomembrane cover is estimated to reduce the infiltration of water for an average precipitation year by 100% (see Appendix A) in the short term. This would lead to a similar reduction of selenium releases at the target cover areas and would be expected to reduce selenium concentrations in Wells Formation groundwater in the vicinity, in addition to reductions predicted to occur without additional action (see Section 3.2.1.1). The geomembrane has a finite life expectancy because it is comprised of man-made materials. Freeze-thaw effects, burrowing animals, and plant succession (grasses to shrubs) could result in damage to the membrane and therefore a reduction in the effectiveness of the cover in reducing percolation through the overburden.

The geomembrane cover is more difficult to install and maintain (e.g., liner and topsoil sliding) than covers constructed of natural materials. A geomembrane cover is an available technology that has been constructed as a full-scale cover system at the South Maybe Canyon Mine (a CERCLA action at a cross valley fill). Geomembrane covers can be constructed using specialized construction techniques. They are more difficult to construct than other types of covers because of problems related to tearing and sliding of the liner. For example, geomembrane materials are manufactured in panels of certain widths and lengths and the panels are connected by seaming using thermal or geochemical processes or by overlapping (USEPA 2004). Temperature fluctuations during installation of geomembranes make welding of the seams difficult and can result in wrinkles in the fabric. Wrinkles can also form during placement of cover soil over the geomembrane layer, especially when the layer is warm and has expanded.

The closure slope generally needs to be flatter than 3:1 to achieve stability of the cover over the geomembrane materials. Cover system slope failures can occur during construction and the primary causes are related to placing soil over the sideslope geomembrane from the top of the slope downward, rather than from the toe of the slope upward and using interface shear strength values that are not representative of field conditions (USEPA 2004). During cover installation on slopes, instability can occur by interface failure, which is slippage at the interface between the upper/lower surface of the geomembrane layer and the overlying/underlying material and by internal failure, which is shearing within the geomembrane layer. For side slopes of 3:1, additional anchoring of the geomembrane is required, and angular gravel or rock is required above a geotextile for stability of this layer. The liner can only be installed in good weather and this, along with quality assurance/quality control (QA/QC) requirements can lead to constructability problems.

3.2.2 Surface Water Remedial Alternatives

Three remedial alternatives for surface water that are best capable of addressing the RAOs were retained and are further evaluated. Alternative SW-6 (treatment of water discharging at Hoopes Spring) is divided into two alternatives; Alternative SW-6a is the existing treatment system (2,000 gpm) and Alternative SW-6b is an expanded treatment system (3,000 gpm).

The remedial alternatives evaluated for surface water are:

- Alternative SW-1 – No Further Action
- Alternative SW-3 – Capillary Covers
- Alternative SW-5 – Geomembrane Covers
- Alternative SW-6a – Treatment of Water Discharging at Hoopes Spring (2,000 gpm system)
- Alternative SW-6b – Treatment of Water Discharging at Hoopes Spring (3,000 gpm system).

The complete detailed analyses for all the surface water alternatives are presented in Table 3-2. The text below provides a summary of the key considerations.

3.2.2.1 Alternative SW-1 – No Further Action

Description

The No Further Action alternative, Alternative SW-1, would leave the Site in its existing condition, and does not include any remedial action, long-term monitoring, or administrative or engineering controls. O&M and groundwater/surface water monitoring for the 2006 and 2013 NTCRAs at the Pole Canyon ODA would continue as per the existing Settlement Agreements.

Assessment

Selenium concentrations in surface water in the Sage Creek/Crow Creek watershed downstream of Hoopes Spring are shown in Figure 3-4. Concentrations are currently above the surface water standard in these stream segments, which represents both an unacceptable ecological risk and an exceedance of an ARAR. There are no human health risks related to selenium concentrations in Sage Creek and Crow Creek.

The surface water flow diagram and selenium load model for Sage Creek/Crow Creek is shown on Figure 3-5. As shown, the majority of the selenium mass flux to surface water in Sage Creek/Crow Creek comes from groundwater discharge at the spring complex. A relatively small amount comes from North Fork Sage Creek (releases from the Pole Canyon ODA that migrate across Sage Valley, primarily in alluvial groundwater), and there are also minor background loads from Sage Creek and Crow Creek upgradient from the influence of Hoopes Spring and South Fork Sage Creek springs. Mass is conserved such that selenium concentrations decrease downstream and are proportional to the dilution with clean flow. Flows are higher during the spring runoff and lower during fall, when conditions are relatively dry (see Figures 3-6a and 3-6b for hydrographs of locations LSS in Lower South Fork Sage Creek, LSV-4 in Sage Creek downstream of Hoopes Spring and South Fork Sage Creek, and CC-1A and CC-WY-01 in Crow Creek). With selenium loads from the springs not generally subject to significant seasonal variation, this results in lower concentrations in the creeks during the spring and higher concentrations during the fall (see Figure 3-4).

The Groundwater Model provides information that supports the Conceptual Site Model. The model simulates a decrease in selenium mass flux in Wells Formation groundwater discharging at Hoopes Spring and South Fork Sage Creek springs over time (see Section 3.2.1.1). Reduction is dependent on four primary factors: (1) the reduction of load that originated from active mining; (2) the effect of post-mining reclamation (i.e., covers) and other water controls implemented by Simplot; (3) the reduction of load from the Pole Canyon ODA as a result of the NTCRAs; and (4) the depletion of the selenium source term for the ODAs over time.

At any given panel, selenium was released from overburden once it was disturbed by active mining. The magnitude of release during the active mining period depends primarily on the area and volume of overburden, the source characteristics, and the amount of water infiltrated. Because both the source term and the amount of water infiltrated is expected to be higher during active mining, this can result in relatively large mass flux of initial release. Once mining ceases and the area is reclaimed (by covering and implementing storm water controls in more recent mining), the release of selenium from overburden decreases. Selenium released in infiltrating water migrates downward to the Wells Formation (a relatively smaller amount from Pole Canyon also migrates to the alluvial groundwater in Sage Valley). Wells Formation groundwater flows south and discharges at Hoopes Spring or South Fork Sage Creek springs. Using the estimated groundwater advective velocity, the relative travel times from each panel to Hoopes Spring can be estimated. As shown in Appendix A, travel times from each panel are anticipated to have a range (primarily because of the size of the panels and the associated distances from individual points within the panel to the springs). Simulated travel times average 10, 18, 22, 31, 43 and 47 years from Panel E, Panel D, Pole Canon ODA, Panel A, Panel B, and Panel C, respectively. Coupling these travel time estimates with the timing of mining at the different panels provides an estimate of the timing of arrival of selenium that was released during active mining. Based on the Groundwater Model, it is estimated that a significant portion of selenium currently arriving at the springs is related to active mining. The load from active mining is anticipated to decrease to essentially zero in the next 10 years.

Simplot has completed a considerable number of post-mining reclamation (i.e., covers) and water controls that have reduced release of selenium from ODAs and transport to Wells Formation groundwater. The Site has approximately 1,060 acres of covered overburden either by post-mining reclamation (Panels C and E, areas of Panels A and D, and the areas at Panel B where mining has been completed) or by 2013 Pole Canyon NTCRA. Placement of post-mining reclamation covers reduces selenium loading due to the reduction of infiltration through overburden. Recent observations in alluvial monitoring wells GW-15, GW-22, and GW-26 (see Section 3.2.3.1) and Wells Formation monitoring well GW-16 (see Section 3.2.1.1) demonstrate the benefits of reclamation covers. Section 3.2.1.1 also outlines the numerous storm water controls Simplot has recently implemented, including run-on and runoff controls at Panels A, C, D, and E; lining of a sediment retention pond at Panel A; and construction of a storm water basin at Panel D. These features also function to reduce the volume of water infiltrating through overburden.

In addition, the 2006 and 2013 NTCRAs have resulted in a significant reduction in selenium load from the Pole Canyon ODA to Wells Formation groundwater, as shown in Table 3-5. The average selenium load to the Wells Formation in the five years prior to the implementation of the 2006 NTCRA in 2007 was estimated at 2.2 pounds per day on average. This was reduced to 0.37 pounds per day by the implementation of the 2006 NTCRA (diverting Pole Canyon Creek flow around the ODA and run-on controls) and further reduced to 0.26 pounds per day by the implementation of the 2013 NTCRA (placing a Dinwoody/chert cover on the ODA). This reduction in mass load is anticipated to have an effect at Hoopes Spring in the next 10 years and to be fully manifested by approximately 2040 (the travel time from the Pole Canyon ODA to Hoopes Spring is approximately 20 to 25 years).

The selenium source concentration of water that has infiltrated through ODAs is assumed to deplete over time. The source term used in the Groundwater Model was based on methods used in NEPA modeling analyses conducted at the Smoky Canyon Mine (HGG 2018; JBR 2007; BLM and USFS 2002). The concentration and depletion rate are based on Site-specific column leach tests and estimated infiltration rates through overburden covers. Figure 3-7 illustrates the source terms used in the modeling analyses, which represent a possible range of source depletion rates. As shown, the source concentration depletes more rapidly early in time (i.e., following placement of ROM backfill) and more slowly later (in the future). The average concentration during the PV 1 period is 0.532 mg/L and the average concentration is 0.136 mg/L for the PV 2 period (see Figure 3-7). As shown in Figure 3-7, the estimated time to decline to the 2nd pore volume (PV) concentration ranges from approximately 45 years (30-year pore volume) to 90 years (60-year pore volume). A reduction in selenium source concentration would result in a proportional reduction in selenium mass flux to Wells Formation groundwater and ultimately to surface water.

As a result of these processes, selenium mass flux in water discharging at the spring complex will decrease over time. Consequently, selenium concentrations in surface water (and fish tissue) in the Sage Creek/Crow Creek watershed will also reduce over time and could ultimately be in the range of the surface water standard.

There are potential unacceptable risks to human receptors (recreational camper or Native American) and potential current unacceptable risk to human receptors (Native American) from ingestion of surface water where arsenic concentrations exceeded the Idaho drinking water standard in surface water seeps downgradient (east) of Panel D (DS-7) and the Pole Canyon ODA (LP-1), and surface water in detention ponds downgradient of Panel D seep DS-7 (DP-7) and Panel E seep (EP-2). No additional actions would be performed and therefore the magnitude of these risks would not change.

3.2.2.2 Alternative SW-3 – Capillary Covers

Description

Alternative SW-3 consists of a capillary cover on the target cover areas (Figure 2-1), as described for Alternative WG-5, to reduce the infiltration of precipitation and consequent release of selenium to Wells Formation groundwater and transport to surface water.

In addition, rock covers would be placed as a physical barrier layer on seeps (DS-7 and LP-1) and detention ponds (DP-7 and EP-2) to prevent direct contact with surface water with arsenic concentrations greater than the MCL. Fences and signs to notify people that the water should not be consumed may be installed in the interim to prevent contact. Alternative SW-3 would include storm water controls, O&M, and long-term monitoring.

Assessment

Human health would be protected through the use of fences and/or signs in the short term and ultimately rock covers to prevent ingestion of surface water in seeps and detention ponds with arsenic concentrations greater than the MCL.

Concentrations of selenium in Sage Creek and Crow Creek downstream of Hoopes Spring are anticipated to decrease over time in surface water in the Sage Creek/Crow Creek watershed. While surface water conditions are expected to improve over time, it is uncertain whether selenium concentrations will ultimately reduce below the water quality standard at all monitoring locations in Sage Creek and Crow Creek.

Installing a capillary cover over the target cover areas would reduce infiltration of water into overburden in this area and subsequent release of selenium to Wells Formation groundwater. This would reduce the mass flux of selenium discharging with Wells Formation groundwater at the spring complex over time and consequently the selenium concentrations in surface water (and fish tissue) in the Sage Creek/Crow Creek watershed downgradient of Hoopes Spring.

3.2.2.3 Alternative SW-5 – Geomembrane Covers

Description

Alternative SW-5 consists of a geomembrane cover on the target cover areas (Figure 2-1), as described for Alternative WG-7, to reduce the infiltration of precipitation and consequent release of selenium to Wells Formation groundwater and transport to surface water.

In addition, rock covers would be placed as a physical barrier layer on seeps (DS-7 and LP-1) and detention ponds (DP-7 and EP-2) to prevent direct contact with surface water with arsenic concentrations greater than the MCL. Fences and signs to notify people that the water should not be consumed may be installed in the interim to prevent contact. Alternative SW-5 would include storm water controls, O&M, and long-term monitoring.

Assessment

Human health would be protected through the use of fences and/or signs in the short term and ultimately rock covers to prevent ingestion of surface water in seeps and detention ponds with arsenic concentrations greater than the MCL.

As described in Section 3.2.2.1, concentrations of selenium in surface water in Sage Creek and Crow Creek downstream from Hoopes Spring are anticipated to decrease over time. While surface water conditions are expected to improve over time, it is uncertain whether selenium concentrations will ultimately reduce below the water quality standard at all monitoring locations in Sage Creek and Crow Creek.

Installing a geomembrane cover on uncovered overburden areas at the target cover areas would reduce infiltration of water into overburden and subsequent release of selenium to Wells Formation groundwater.

Installing a geomembrane cover is estimated to reduce the infiltration of water for an average precipitation year by 100% (see Appendix A) in the short term. This would lead to a similar reduction of selenium releases to Wells Formation groundwater (and subsequent transport to surface water via groundwater discharge at the spring complex) at the target cover areas, in addition to reductions predicted to occur without additional action (see Section 3.2.2.1). However, the geomembrane has a finite life expectancy because it is comprised of man-made materials. Freeze-thaw effects, burrowing animals, and plant succession (grasses to shrubs) could result in damage and therefore a reduction in their effectiveness in reducing percolation through the overburden.

Geomembrane covers can be constructed using specialized construction techniques. They are more difficult to construct than other types of covers because of problems related to tearing and sliding of the liner (see Section 3.2.1.4 for more details).

3.2.2.4 Alternative SW-6 – Treatment of Water Discharging at Hoopes Spring

Description

Alternative SW-6 consists of water treatment at Hoopes Spring and would use the existing Hoopes WTP, which was constructed in 2014 and modified in 2017 for a biological water treatment pilot study implemented to support the FS (Formation 2014b, 2017). Alternative SW-6 would have two options:

- Alternative SW-6a – Treatment of Water Discharging at Hoopes Spring (2,000 gpm system)
- Alternative SW-6b – Treatment of Water Discharging at Hoopes Spring (3,000 gpm system)

Alternative SW-6a would entail continued operation of the existing UF/RO FBR pilot treatment system, which is shown in Figure 3-8. Alternative SW-6b would add a third treatment train to the system to bring the design flow rate to 3,000 gpm.

In addition, rock covers would be placed as a physical barrier layer on seeps (DS-7 and LP-1) and detention ponds (DP-7 and EP-2) to prevent direct contact with surface water with arsenic concentrations greater than the MCL. Fences and signs to notify people that the water should not be consumed may be installed in the interim to prevent contact. Alternative SW-6 would include O&M and long-term monitoring.

Assessment

Human health would be protected through the use of fences and/or signs in the short term and ultimately rock covers to prevent ingestion of surface water in seeps and detention ponds with arsenic concentrations greater than the MCL.

Selenium concentrations in the Sage/Crow Creek watershed downstream from Hoopes Spring and South Fork Sage Creek springs would be immediately reduced by treatment. The pilot treatment system has removed approximately 40% of the total selenium mass flux emanating from Hoopes Spring and South Fork Sage Creek springs with a corresponding reduction in concentrations in the downstream portions of Sage Creek and Crow Creek. If the treatment system were increased in total capacity from 2,000 to 3,000 gpm, the reduction in mass flux would be on the order of 60% for current conditions.

Selenium concentrations recently measured in surface water at HS-3 (downstream of Hoopes Spring before the confluence with Sage Creek), LSV-4 (in Sage Creek downstream of the inflows from Hoopes Spring and South Fork Sage Creek), and CC-WY-01 (Crow Creek at the Idaho/Wyoming border) are shown in Figure 3-9. The Hoopes WTP was operational during this period. The estimated concentrations that would have been measured without the treatment plant are also shown, as are the estimated concentrations if a 3,000 gpm system had been present, operating at the same treatment efficiency as the existing facility. As shown, the measured concentrations have all been above the water quality standards (16.7 µg/L for Sage Creek and 4.2 µg/L for Crow Creek). Selenium concentrations have been in the range of the water quality standards at LSV-4 and CC-WY-01 during spring high-flow conditions. Estimated concentrations assuming a 3,000 gpm treatment system are still generally above the water quality standards; however, they are below the water quality standard at LSV-4 and in the range of the standard at CC-WY-01 during spring high-flow conditions.

Selenium loads discharging from the springs are expected to decrease in the future as discussed in Section 3.2.2.1. Selenium concentrations in the spring discharge water would decrease proportionally. Selenium concentrations would be reduced to below water quality standards more quickly with treatment.

3.2.3 Alluvial Groundwater Remedial Alternatives

Three remedial alternatives for alluvial groundwater that are best capable of addressing the RAOs were retained and are further evaluated. The complete detailed analysis of remedial alternatives for alluvial groundwater is provided in Table 3-3. The text below provides a summary of the key considerations.

The remedial alternatives evaluated for alluvial groundwater are:

- Alternative AG-1 – No Further Action
- Alternative AG-3 – Institutional Controls (ICs) and MNA
- Alternative AG-5 – Permeable Reactive Barrier, ICs and MNA.

3.2.3.1 Alternative AG-1 – No Further Action

<u>Description</u>

No additional actions would be taken under Alternative AG-1. O&M and groundwater/surface water monitoring for the 2006 and 2013 NTCRAs at the Pole Canyon ODA would continue per the existing Settlement Agreements.

Assessment

The conceptual model for transport of water from the Pole Canyon ODA is shown on Figure 3-10. As shown, water is released to the alluvial groundwater and also flows from the ODA toe seep (sampling location LP-1). Flow at the LP-1 seep infiltrates into the alluvium before it reaches the outflow from the Upper Pole Canyon Creek bypass pipeline (except when the bypass pipeline is not operating as designed for the Pole Canyon NTCRA water management features). Unaffected water from the pipeline flows into the valley or infiltrates into the shallow alluvium and migrates to a large boggy wetland area where water flows at or near the surface before discharging to North Fork Sage Creek. The alluvial groundwater flows into the valley into the same large boggy wetland area, losing water to the underlying Wells Formation aquifer as it migrates (Wells Formation groundwater flows south and discharges to the surface at Hoopes Spring). Selenium is transported with the water from Pole Canyon ODA. A selenium mass flux model is shown in Figure 3-10 for current conditions. As shown, the estimated average selenium mass flux in alluvial groundwater just after surface water from LP-1 infiltrates is 0.2 pounds per day (0.04 pounds per day from alluvial groundwater from beneath the ODA plus 0.2 pounds per day from the LP-1 flow). It is estimated that 0.05 pounds per day of selenium transports to North Fork Sage Creek from alluvial flow. Therefore, approximately 70% of the selenium is lost from the alluvial system between the ODA and North Fork Sage Creek. A portion migrates to the underlying Wells Formation and the remainder is likely lost to attenuation in the organic-rich wetland area in Sage Valley.

The location of alluvial wells and other pertinent features are shown in Figure 3-11. Concentrations of selenium measured in these wells over time are shown in Figure 3-12. The selenium concentrations in Pole Canyon (GW-26) gradually increased after the well was installed in 2009 (Figure 3-12). The upward trending concentrations at GW-26 approached concentrations measured at LP-1, which monitors the toe seep discharge from ODA (approximately 360 feet upgradient of GW-26). LP-1 concentrations had also increased following the construction of the Pole Canyon Creek bypass pipeline in 2007.

Prior to the pipeline construction, the creek flow exited the ODA toe and generally infiltrated into the alluvium (except during high flow events when it flowed across the valley into North Fork Sage Creek). The flow is now conveyed to a location approximately 400 feet downgradient of GW-26. The Dinwoody/chert cover that was installed on the ODA in 2015 has had a significant effect on selenium concentrations at GW-26, due to the reduction in percolation of water into the ODA (and subsequent release of selenium) and by delivering clean water for infiltration to the alluvial system upgradient of GW-26. Selenium concentrations at this well have dropped from approximately 6 mg/L in 2015 to less than 2 mg/L in 2020. At GW-15, at the mouth of Pole Canyon, a similar reducing trend is shown with recent concentrations around 0.025 to 0.14 mg/L; in the range of the MCL. Farther downgradient in Sage Valley, selenium concentrations in well GW-22 have generally been higher in groundwater from the shallower well screen (98 feet) than in groundwater from the deeper screen (150 feet). At both well screens, selenium concentrations in groundwater have decreased since the cover was installed on Pole Canyon ODA. In the deeper screen selenium concentrations in groundwater have been below the MCL the last two years. In the shallower screen selenium concentrations in groundwater have recently been in the range of 0.1 mg/L.

The Groundwater Model indicates that the rate of release of selenium from the Pole Canyon ODA will continue to decrease over time (Figure 2-4), and as indicated by the monitoring data selenium mass flux and concentrations in the alluvial aquifer are also expected to decline.

There are no environmental risks associated with alluvial groundwater. Human health would not be protected because use of alluvial groundwater with selenium concentrations above the MCL as a source of drinking water would not be prevented.

3.2.3.2 Alternative AG-3 – Institutional Controls (ICs) and MNA

Description

Alternative AG-3 would entail deed restrictions on Simplot-owned land in Sage Valley to prevent the use of alluvial groundwater with selenium concentrations above MCLs as a domestic water supply. Specific performance objectives (e.g., prevent access or use of alluvial groundwater until cleanup levels are met) would be included in the ROD and then specified as restrictions on the property deed. This alternative would require an ICIAP to specify how the deed restrictions will be implemented, maintained, enforced, modified, and terminated (if applicable). Deed restrictions would only be applied to areas where selenium concentrations exceed the MCL and would ultimately be removed when the MCL is met throughout Simplot-owned land in Sage Valley.

Assessment

Deed restrictions on Simplot land in Sage Valley would prevent the use of alluvial groundwater with selenium concentrations above the MCL as a source of drinking water and protect human health. The same reduction of selenium concentrations in alluvial groundwater would occur as Alternative AG-1.

3.2.3.3 Alternative AG-5 – Permeable Reactive Barrier, ICs and MNA

Description

Alternative AG-5 is a PRB that would consist of a trench excavated downgradient of the ODA where no overburden is present in the Pole Canyon Creek channel, keyed into bedrock on the bottom and sides, and aligned perpendicular to flow to intercept seep water from LP-1 before it infiltrates into the alluvium (Figure 3-13). The PRB would be filled with structural backfill (e.g., silica sand), a short-term carbon source (e.g., alfalfa hay or grass hay), and a long-term carbon source (e.g., wood chips). The reactive media would use chemical and microbial processes to chemically reduce and transform selenium from selenate to selenite and ultimately to elemental selenium. ICs under Alternative AG-5 would include deed restrictions on Simplot-owned land in Sage Valley to prevent the use of shallow alluvial groundwater with selenium concentrations above the MCL as a domestic water supply. O&M and long-term groundwater and surface water monitoring would be performed to evaluate the performance and effectiveness of the remedy.

<u>Assessment</u>

The alluvial groundwater in the vicinity of the ODA seep (sampled at LP-1) is approximately 20 feet below ground surface. Depending upon the competency of the bedrock material, a PRB could be constructed to a depth of 20 feet or more and could treat the top few feet of alluvial groundwater directly. The seep water could be treated as it infiltrates into the subsurface. Initial results from a pilot treatability study at the nearby Conda Mine indicate that PRB treatment efficiency in removing selenium is in the range of 95% (Formation 2019b). The current estimate of average selenium mass flux at LP-1 is 0.2 pounds per day and is 0.04 pounds per day in the alluvial groundwater before LP-1 infiltrates (Formation 2019b). Treatment of seep water would therefore remove 75% of the selenium mass flux in alluvial groundwater immediately downgradient of the Pole Canyon ODA.[2] Estimated groundwater travel times from the ODA toe are approximately 1 month to GW-26, 2 months to GW-15, 8 months to GW-22, and 2 years to North Fork Sage Creek. Reductions of selenium concentrations in alluvial groundwater and surface water in North Fork Sage Creek would be expected in these time frames. Therefore, selenium concentrations would be expected to be reduced to below the MCL at all alluvial groundwater monitoring locations outside Pole Canyon (i.e., in Sage Valley) within 1 year.

The PRB treatment media will eventually become exhausted and will need to be replaced. Pilot studies are being performed at Conda Mine to evaluate the treatment performance over time but there are no data to estimate actual long-term performance. Expectations are that complete treatment removal will be needed every 10 to 20 years.

3.2.4 Solids and Soils Remedial Alternatives

Three remedial alternatives for solids and soils that are best capable of addressing the RAOs were retained and are further evaluated. The complete detailed analysis of remedial alternatives for solids and soils is provided in Table 3-4. The text below provides a summary of the key considerations.

[2] [1-(0.17*0.05+0.04)/(0.17+0.04)]

The remedial alternatives evaluated for solids and soils are:

- Alternative S-1 – No Further Action
- Alternative S-2 – Rock Covers on Soils in Seep and Riparian Areas
- Alternative S-3 – 2-Foot-Thick Dinwoody or Salt Lake Formation Covers on Uncovered Areas of ODAs and Rock Covers on Soils in Seep and Riparian Areas

3.2.4.1 Alternative S-1 – No Further Action

Description

The No Further Action alternative, Alternative S-1, would leave the Site in its existing condition. The Site has approximately 1,060 acres of covered overburden (out of a total of 1,422 acres; or 75% covered) either by post-mining reclamation (Panels C and E, areas of Panels A and D, and the areas at Panel B where mining has been completed) or by 2013 Pole Canyon NTCRA. Uncovered overburden at Panels A and D comprise an area of 360 acres. O&M and groundwater/surface water monitoring for the 2006 and 2013 NTCRAs at the Pole Canyon ODA would continue as per the existing Settlement Agreements.

Assessment

There are two issues related to soils: (1) risks to ecological receptors (i.e., deer mice and bird populations) from exposure to selenium due to ingestion of soil, vegetation, and invertebrates on uncovered overburden; and; (2) risks to seasonal ranchers from exposure to arsenic, primarily due to ingestion of beef from cattle grazed at the Site.

The PRG for small mammal populations is compared to the 95% upper confidence limit (95UCL) of the mean selenium concentration in soil on an ODA basis (i.e., for Panel A, Panel C, Panel D, Panel E and Pole Canyon ODA). The available data for current surface soil conditions are shown in Appendix C in Table C-1. This dataset has been updated from the RI dataset to include reclaimed areas where more recent soil samples have been collected and the cover installed on Pole Canyon as part of the NTCRA in 2015 (see Appendix C for more details). The estimated 95UCL of the mean selenium concentration for each panel area is shown on Table 3-6 (see Appendix C for detailed calculations). The table also shows calculated HQs for each area. As shown, calculated HQs are above 1 for all ODAs except for the Pole Canyon ODA. Panels B, C and E, which have complete Dinwoody covers have estimated HQs between 1.4 and 2.8. Panel A, which has Dinwoody covers in some areas, has an estimated HQ of 5.8 and Panel D, which has a chert cover on pit D-3, has an HQ of 7.6. The Site-wide HQ is 3.9.

It is unlikely that there are risks to small mammal populations at these levels based on the data collected at the Conda Mine specifically to assess the effects of selenium concentrations in exposed mining materials on small mammal populations. Ecological risk assessments for both the Smoky Canyon and Conda sites indicated potentially unacceptable risk to small mammal populations from exposure to selenium. To test this conclusion, and to complement the Site-Specific Ecological Risk Assessments (SSERAs) (Formation 2015, 2016), a small mammal population effects study was designed to evaluate the impacts of elevated selenium exposure on small mammal populations at Conda. Study locations were selected to represent the range of risks calculated for small mammals and included areas with the highest calculated risk (non-remediated overburden areas) and areas with low or background risks (i.e., previously remediated areas, and non-mined reference areas). Endpoints measured in the study included selenium tissue concentrations, population densities of individuals (i.e., per unit area), body weight, and sex ratio information.

The data collected during the study are presented in the Conda Final Year 3 Data Summary Report (DSR; Formation 2018) and suggested that robust populations exist on the ODAs at Conda. Despite differences in selenium exposure between sites located on mine waste and reference sites, the average population density of the deer mice was not significantly different between the locations on overburden areas and in the reference area ($p < 0.05$) (Formation 2018). Deer mouse density estimates over three years averaged 108.5 animals/acre on the soil/overburden sampling areas and 107.8 animals/acre on the undisturbed reference area. Both male and female mice, from the range of expected age classes, were present each year at all sampling locations with both juvenile and reproductive animals consistently present. At several locations, both in areas with high selenium exposure and in the reference area, several animals were re-captured in consecutive years during the study indicating year-to-year survival of at least a portion of the population.

The results of the Conda population study show that exposure to selenium in the mined areas at Conda is not resulting in a significant adverse effect on deer mouse populations. Because no effects were observed, the data cannot be used to identify a threshold selenium concentration for effects on populations. However, the data represent a range of environmental selenium concentrations that are clearly below the population effects threshold for selenium. Similarly, at the Champ, North Maybe, and South Maybe Canyon mines (Arcadis 2017 and 2018), the small mammal studies concluded that the results indicated no evidence of adverse effects to small mammal populations due to site related chemical exposure and that differences in small mammal populations were due to differences in habitat between the study sites.

The soils within the Conda small mammal population study sites were sampled in 2019 to determine the concentrations of selenium to which the small mammals inhabiting those areas were exposed. The Conda selenium concentrations at the small mammal population study sites ranged from 58.8 to 134 mg/kg. The median concentration was equal to 70.3 mg/kg while the mean and the 95UCL of the mean equaled 84.7 and 102 mg/kg, respectively. These represent soil selenium concentrations at which no significant effects to small mammal population density and abundance were observed. The highest 95UCL of the mean selenium concentration measured at Smoky Canyon is 16.3 mg/kg at Panel D (Table 3-6). This concentration is considerably lower than the lowest concentration measured in the Conda study, and based on the study at Conda, there is high confidence of a low likelihood of effects on the abundance/density for small mammals due to exposure to selenium at Smoky Canyon Mine.

The PRG for bird populations is compared to the UCL mean selenium concentration in soil on a Site-wide basis. Using the available data, the calculated value is 7 mg/kg (Table 3-7). The calculated concentration corresponds to an HQ of 2.9 using the toxicity reference value (TRV) for birds presented in in the SSERA. Since the completion of the SSERA, NuWest Inc. has developed a set of selenium TRVs for bird receptors based on dietary modelling to egg-based selenium effects levels (Arcadis 2018). These TRVs represent a good estimate of risk to bird receptors because they are based on the measures of reproductive effects specifically caused by selenium in birds (i.e. egg hatchability). When compared to the SSERA TRVs, which were derived using generic TRV derivation techniques not specifically based on the primary mode of action for selenium, the NuWest TRVs likely provide a better estimate of potential toxicity to bird populations. The NuWest lowest-observed-adverse-effect-level (LOAEL) TRV (3.0 mg/kg body weight [BW]/day) is approximately five-times higher than the geometric mean no-observed-adverse-effect-level (NOAEL) TRV (0.61 mg/kg BW/day) used to calculate the bird PRG. By extension, the HQ corresponding with the bird PRG would also be approximately five-times lower if the NuWest TRV were used in the calculation (i.e. below 1).

Spatial scale is important for population-level endpoints when the area of exposure (and area considered for remedial action) is smaller than the overall scale occupied by a population; or when comparing receptors for which effective population size requires substantially different areas or habitats such as small mammal and small bird populations.

As discussed above, the size of the ODAs means that most individual deer mice in the sub-population may spend their entire life cycles exposed to elevated selenium concentrations. In contrast, the sub-populations of small birds at the Site are much more mobile and their characteristically lower population density makes predicting population-level effects more uncertain than for the small mammals.

As discussed in Page and Ritter (1999), bird populations adapt to their habitat based on scale of the available habitat. In their management recommendations for sagebrush-steppe habitat, the authors discuss the management of habitat based on the size of the available contiguous habitat. For example, the vesper sparrow is a small omnivorous bird species similar in size to the American robin (used as the representative receptor in the SSERA). Studies in Montana grasslands show that the home range of the vesper sparrow ranges from less than 1 to 7.5 acres (Reed 1985, 1986). The vesper sparrow is a common inhabitant of the sagebrush-steppe habitat and is commonly found in habitats dominated by grasses. Vesper sparrows have been observed on reclaimed ODAs at several locations at Smoky Canyon. The sparrows, like the American robin, also eat a combination of terrestrial invertebrates and vegetation. Therefore, they provide a good real-world example of a small omnivorous bird (represented by the default surrogate species American robin as assessed in the SSERA) that would commonly be found foraging within the interior and on the edges of the mine panels at Smoky Canyon.

The population density of the sparrow in sagebrush and reclaimed mined areas in Wyoming is approximately equal to 0.5 birds per acre (Schaid et al. 1983). When the population density of the animals estimated in the Conda small mammal study (Formation 2018) is considered, more than 10,000 deer mice may utilize the available habitat in a 100-acre area for all of their activity, but 50 or fewer sparrows may utilize the same habitat and for many only part of their total activity given the bird's ability to move on and off of the mine panel quickly. Because of their lower population density (i.e., smaller number of individuals using an area) and mobility, a much smaller fraction of small bird populations is expected to be exposed within a mine panel.

The size of a biological population depends on the intrinsic characteristics of a species and the available habitat mosaic (Thomas 1990). In an ecological evaluation, the functional size also depends on the purpose of the evaluation. In this case, some minimum sustainable population size estimate is needed to assess whether a population of birds (e.g., vesper sparrows or robins) on the ODAs would be self-sustaining, even if selenium were at background concentrations. Thomas (1990) suggests that there is no single 'magic' population size that guarantees the persistence of a population of animals. Minimum Viable Population (MVP) refers to the smallest population size required to be persistent over a period of time (e.g., over 40 generations) given pressures from genetic differences, environmental variables, natural catastrophes, or other factors. As discussed in Reed et al. (2003), population viability analysis (PVA) provides a means for predicting the probability of extinction among populations taking into account population stochasticity (i.e. randomness) and deterministic factors such as habitat changes and effects from environmental contaminants. Reed et al. (2003) reviewed PVA analysis for a wide range of species and found that the MVP (40 generations) for passerine birds (6 species) range from about 2,000 to over 25,000. An overall average MVP for 25 bird species (mixed families) was approximately 6,500 (from Appendix in Reed et al. 2003). These are rough estimates, but they are useful to assess whether habitat patches the size of the Smoky mine panels could sustain populations of small bird species such as the vesper sparrow. While the vesper sparrow was not included in the Reed et al. (2003) assessment, the MVP for the song sparrow (similar food ingestion, habitat use, and range size) was estimated at nearly 10,000 individuals. If the MVP for the vesper sparrow were on the low end of the MVP range at 2,000 individuals, the population would require 4,000 acres (based on the density estimate in Schaid et al. [1983]), which is considerably larger than any of the mine panels at Smoky Canyon and most closely corresponds to a site-wide exposure unit.

In general, however, the habitats available on the Smoky mine panels are of only marginal quality for most of the small bird species that are common in sagebrush-steppe habitat. The open grassy habitat on the ODAs lack a significant shrub layer and provide suboptimal habitat for shrubland species such as the black-throated sparrow, green-tailed towhee, and lark sparrow and no viable habitat for sagebrush obligate species such as the sage sparrow or Brewer's sparrow. The lack of trees within the interior of the ODAs likely precludes the presence of woodland species such as the gray flycatcher in all but the wooded edges of the panels (Page and Ritter 1999). Even the vesper sparrow, which is well adapted to and generally prefers grassy patches in the sagebrush-steppe habitat has been shown to be present at lower densities in a mining disturbed reclaimed habitat in Montana versus unmined grassy big sagebrush habitat (Schaid et al. 1983).

The lack of high-quality attractive habitat is important because, as shown by Ohlendorf (1989) at Kesterson Reservoir in California, large and relatively high-quality habitats can serve as an attractive nuisance where small-scale effects to breeding birds feeding in the high-quality habitats can stress local populations by attracting new birds annually to the contaminated habitat. The small patches of low-quality habitat found at Smoky Canyon are unlikely to be large enough to serve as attractive nuisances resulting in significant habitat sinks for the regional populations of the common bird species that may utilize them.

Based on this information, when habitat type, quality, use, and population demographics are taken into consideration, exposure to the entire sitewide population of small birds is the most relevant scale at which to apply the PRG.

The PRG for arsenic in soil to protect future seasonal ranchers is compared to the 95UCL mean concentration on a Site-wide basis. The available data for current surface soil conditions are shown in Appendix C in Table C-1. There are fewer data than for selenium, because soil samples collected as part of reclamation sampling on Panels B and C were not analyzed for arsenic. The statistical analysis of the arsenic data is shown on Table 3-8. In this analysis, the Pole Canyon ODA arsenic 95UCL mean concentration was used for Panels B and C which have topsoil at the surface. As shown, the area-weighted 95UCL mean concentration is calculated at 10.2 mg/kg; below the PRG of 11.5 mg/kg. Therefore, the PRG is met under current conditions and this issue is not discussed further in the detailed analysis.

3.2.4.2 Alternative S-2 – Rock Covers on Soils in Seep and Riparian Areas

<u>Description</u>

Alternative S-2 consists of rock covers of chert/limestone, or equivalent, that would be placed as a physical barrier layer on overburden seep and riparian areas (DS-7, ES-4, and LP-1) downstream of ODAs (Figure 3-14) to prevent terrestrial biota from contacting or ingesting soil with elevated selenium concentrations.

Assessment

As for Alternative S-1, the PRG for arsenic in soil is met under current conditions, and therefore, there are no risks to seasonal ranchers from exposure to arsenic in soil. Placement of rock covers on soil in seep and riparian areas would prevent exposure of small mammal (e.g., deer mice) and bird (e.g., American robin) populations to selenium in soil in seep and riparian areas downstream of Panel D, Panel E, and the Pole Canyon ODA (DS-7, ES-4, and LP-1). Alternative S-2 would provide the same protection for small mammal and bird populations on uncovered ODAs as Alternative S-1 at a cost of $256,000.

3.2.4.3 Alternative S-3 – 2-Foot-Thick Dinwoody or Salt Lake Formation Covers on Uncovered Areas of ODAs and Rock Covers on Soils in Seep and Riparian Areas

Description

Alternative S-3 consists of 2-foot Dinwoody or Salt Lake Formation covers that would be constructed on all uncovered areas of Panels A and D (Figure 2-18). The cover would be vegetated with native grass/forb species to control erosion. Storm water run-on and runoff controls would be constructed to convey water off or around the backfilled pits and ODAs. Rock covers of chert/limestone would be placed as a physical barrier layer on overburden seep and riparian areas (DS-7, ES-4, and LP-1) downstream of ODAs to prevent exposure to selenium in soil. This alternative would also include short-term ICs such as grazing controls and land-use controls to restrict access to cover areas while the cover vegetation matures. Inspections and O&M would be required to maintain the effectiveness and permanence of the covers and components of the storm water run-on/runoff controls.

Assessment

Covering the uncovered areas of Panels A and D with Dinwoody or Salt Lake Formation would reduce the selenium concentrations at the surface. An estimate of the resultant conditions is shown in Table 3-9. In this analysis, the selenium concentrations at Panels A and D were replaced with the average value for Panel E, where a Dinwoody cover has been installed. As shown, calculated HQs for small mammals would range up to 2.8 for individual panels. The Site-wide average concentration of 1.55 mg/kg corresponds to an HQ of 1.0 for bird populations. Based on the evaluation of current conditions described in Section 3.2.4.1, this would provide minimal additional protection for small mammal and bird populations at a cost of $20 Million.

4.0 COMPARATIVE ANALYSIS

This section presents a comparative analysis of the media-specific remedial alternatives developed for the Site. The purpose of this analysis is to compare the advantages and disadvantages of each alternative brought forth in the detailed analysis against the threshold and balancing criteria presented in Section 3. The comparison focuses on the significant areas of difference, especially identification of any alternative that is clearly superior in meeting a criterion and provides the rationale for recommending which medium-specific alternative is best suited for inclusion in the overall remedy for the Site.

4.1 Wells Formation Groundwater

The remedial alternatives evaluated in the detailed analysis were as follows:

- Alternative WG-1 – No Further Action
- Alternative WG-3 – Institutional Controls (ICs)
- Alternative WG-5 – Capillary Covers, ICs and MNA
- Alternative WG-7 – Geomembrane Covers, ICs and MNA

Institutional controls are included in each action alternative and provide protection of human health by placing deed restrictions on Simplot's land in Sage Valley to prevent use of groundwater with selenium concentrations above the MCL as a domestic water supply. The key difference between the alternatives is the type of covers to be placed on the target cover areas.

Overall Protection of Human Health and Environment

Alternative WG-1, the No Further Action alternative does not provide protection of human health. There are no significant differences between remedial alternatives WG-3, WG-5 or WG-7 in terms of overall protection of human health and the environment. Each one provides immediate protection of human health through ICs. There are no environmental risks associated directly with Wells Formation groundwater.

Compliance with ARARs

Site data and the Groundwater Model simulation indicates that mass flux of selenium from the ODAs to Wells Formation groundwater will reduce over time. This is expected to result in a general reduction in selenium concentrations in groundwater, with specific effects being dependent on the physical location of the well screen relative to source areas and groundwater flow paths. The prediction shows reductions continuing in 2060; the limit of the modeling duration. While groundwater conditions are expected to improve over time, it is uncertain whether selenium concentrations will ultimately reduce to below the MCL at all monitoring locations.

Installing a capillary cover (Alternative WG-5) or a geomembrane cover (Alternative WG-7) would reduce infiltration of water into overburden in the target cover area and subsequent release of selenium to Wells Formation groundwater. This would be expected to further reduce selenium concentrations in downgradient areas. The relative magnitude of the estimated reduction of selenium mass flux to the Wells Formation is approximately:

- 23% for Panel D and 11% for Panel E for Alternative WG-5
- 40% for Panel D and 19% for Panel E for Alternative WG-7

The time frame for improvements in groundwater quality range from 10 to 20 years (the range of travel times from the target cover areas to the springs complex, where Wells Formation groundwater discharges to surface water).

Therefore, Alternative WG-7 has the greatest reduction and therefore greatest chance of meeting ARARs in the shortest time frame, with Alternative WG-5 providing slightly less reduction, and Alternative WG-3 the least.

Long-Term Effectiveness and Permanence

There are no significant differences between remedial alternatives WG-3, WG-5, or WG-7 in terms of long-term effectiveness and permanence. They all provide protection of human health by placing deed restrictions on Simplot's land in Sage Valley to prevent use of groundwater with selenium concentrations above the MCL as a domestic water supply. The magnitude of residual risk after response actions have been met is similar under Alternatives WG-3, WG-5, and WG-7; the volume of overburden is the same and selenium concentrations in Wells Formation groundwater is expected to be similar over time.

Reduction of Toxicity, Mobility, and Volume through Treatment

None of the remedial alternatives include treatment and therefore there is no difference in performance against this criterion.

Short-Term Effectiveness

Alternatives WG-5 and WG-7 would be protective of the community and workers during remedial actions and environmental impacts would be minimal. Alternative WG-7 may result in the shortest time to achieve response objectives (i.e., meeting MCLs throughout the aquifer), with Alternative WG-5 have a slightly lower effect and Alternative WG-3 the lowest, although the differences are relatively minor.

Implementability

Geomembrane covers (Alternative WG-7) are more generally difficult to construct than other types of covers because of potential problems related to tearing and sliding of the liner. However, geomembrane covers have been constructed locally (i.e., at the South Maybe Mine) and at other sites in the region. Construction of capillary covers (Alternative WG-5) would be technically feasible and would not require specialized construction techniques or special access logistics. Simplot has installed covers using similar materials at the Smoky Canyon Mine. Institutional controls (Alternative WG-3) would be easy to implement; Simplot owns the land where they would be applied.

Cost

Alternative WG-3 uses ICs as the long-term remediation strategy and is the most inexpensive of the remedial alternatives for Wells Formation groundwater at a present worth cost of $940,000. Alternative WG-5 entails installing a capillary cover at the target cover areas at a present worth cost of $31 Million. Alternative WG-7 entails installing a geomembrane cover at the target cover areas at a present worth cost of $70 Million.

Summary

Simplot has completed a considerable number of actions that have reduced release of selenium from ODAs and transport to Wells Formation groundwater. The primary amongst these are construction of covers and associated storm water controls on ODAs. The Site has approximately 1,060 acres of covered overburden (out of a total of 1,422 acres; or 75% covered) either by post-mining reclamation (Panels C and E, areas of Panels A and D, and the areas at Panel B where mining has been completed) or by 2013 Pole Canyon NTCRA. In addition, Simplot has implemented water management actions to divert water from ODAs; most notably the 2006 Pole Canyon NTCRA to divert Pole Canyon Creek flow around the Pole Canyon ODA, as well as numerous run-on and run-off control features and detention/infiltration basins.

Mass flux of selenium in Wells Formation groundwater will reduce over time. The estimated reduction is dependent primarily on four factors: (1) the reduction of load that originated from active mining; (2) the effect of post-mining reclamation (i.e., covers) and other water controls implemented by Simplot; (3) the reduction of load from the Pole Canyon ODA as a result of the NTCRAs; and (4) the depletion of the selenium source term for the ODAs over time.

As the mass flux of selenium in Wells Formation groundwater decreases it is expected to result in a general reduction in selenium concentrations in groundwater, with specific effects being dependent on the physical location of the well screen relative to source areas and groundwater flow paths dictated by stratigraphic and structural conditions. Reductions in selenium concentrations in Wells Formation groundwater are expected to occur over the next 10 to 20 years as a result of the migration of selenium associated with active mining and the effects of the Pole Canyon NTCRAs and over the next 50 to 100 years as a result of the source depletion. While groundwater conditions are expected to improve over time, it is uncertain whether selenium concentrations will ultimately reduce to below the MCL at all monitoring locations. Alternative WG-5 (capillary cover) would add to these reductions by reducing load by approximately 58% at the target cover areas. Alternative WG-7 (geomembrane cover) is predicted to reduce loading by 100% in the short term; however, the geomembrane performance could be reduced if it is compromised over the longer term.

Based on the Conceptual Site Model and understanding the limitations of the modeling, Alternative WG-5 (installing a capillary cover over the target cover areas) performs the best against the evaluation criteria. It provides additional source control compared to current conditions and is cost-effective. Long-term groundwater monitoring will allow for an evaluation of whether the reductions in selenium occur more quickly or more slowly than model simulations. In the event that groundwater quality improvements occur more slowly than expected additional actions could be considered and selected as part of the 5-year review process.

4.2 Surface Water

The remedial alternatives evaluated in the detailed analysis were as follows:

- Alternative SW-1 – No Further Action
- Alternative SW-3 – Capillary Covers
- Alternative SW-5 – Geomembrane Covers
- Alternative SW-6a – Treatment of Water Discharging at Hoopes Spring (2,000 gpm system)
- Alternative SW-6b – Treatment of Water Discharging at Hoopes Spring (3,000 gpm system)

<u>Overall Protection of Human Health and Environment</u>

Alternative SW-1, No Further Action, is not protective of human health. The other alternatives protect human health by placement of rock covers as a physical barrier layer on seeps (DS-7 and LP-1) and detention ponds (DP-7 and EP-2) to prevent direct contact with surface water with arsenic concentrations greater than the MCL.

Selenium concentrations are currently above the surface water standard in Sage Creek and Crow Creek downstream from the springs complex, which represents both an unacceptable ecological risk and an exceedance of an ARAR. There are no human health risks related to selenium concentrations in Sage Creek and Crow Creek.

The Groundwater Model estimates that selenium mass flux in Wells Formation groundwater discharging at the springs complex will reduce over time. This will result in a proportional reduction in selenium concentrations in surface water (and in fish tissue) in the Sage Creek/Crow Creek watershed, which could ultimately be in the range of the surface water standard. As previously mentioned, the reduction is a result of four factors (1) the reduction of load that originated from active mining; (2) the effect of post-mining reclamation (i.e., covers) and other water controls implemented by Simplot; (3) the reduction of load from the Pole Canyon ODA as a result of the NTCRAs; and (4) the depletion of the selenium source term for the ODAs over time.

The arrival of selenium released from active mining at the springs depends on the timing of mining and the travel time in Wells Formation groundwater to the springs (Appendix A). Coupling these travel time estimates with the timing of mining at the different panels provides an estimate of the arrival of selenium that was released during active mining. Based on the Groundwater Model, it is estimated that a significant portion of selenium currently arriving at the springs is related to active mining. The load from active mining is anticipated to decrease to essentially zero in the next 10 years.

Simplot has completed a considerable number of post-mining reclamation (i.e., covers) and water controls that have reduced release of selenium from ODAs and transport to Wells Formation groundwater. For example, the Site has approximately 1,060 acres of covered overburden either by post-mining reclamation (Panels C and E, areas of Panels A and D, and the areas at Panel B where mining has been completed) or by 2013 Pole Canyon NTCRA. Placement of post-mining reclamation covers reduces selenium loading due to the reduction of infiltration through overburden.

In addition, the 2006 and 2013 NTCRAs have resulted in a significant reduction in selenium load from the Pole Canyon ODA to Wells Formation groundwater. Based on the timing of the actions and the estimated Wells Formation groundwater travel time from the Pole Canyon to the springs complex, this is estimated to result in a significant reduction in selenium mass load in surface water in the next 10 years.

The selenium source concentration of water that has infiltrated through ODAs is assumed to deplete over time. The source term used in the Groundwater Model was based on methods used in NEPA modeling analyses conducted at the Smoky Canyon Mine (HGG 2018; JBR 2007; BLM and USFS 2002). The concentration and depletion rate are based on Site-specific column leach tests and estimated infiltration rates through overburden covers. The source concentrations are expected to deplete more rapidly early in time (i.e., following placement of ROM backfill) and more slowly later (in the future). The average concentration during the PV 1 period is 0.532 mg/L and the average concentration is 0.136 mg/L for the PV 2 period (see Figure 3-7). As shown in Figure 3-7, the estimated time to decline to the 2nd pore volume (PV) concentration ranges from approximately 45 years (30-year pore volume) to 90 years (60-year pore volume). A reduction in selenium source concentration would result in a proportional reduction in selenium mass flux to Wells Formation groundwater and ultimately to surface water.

It is important to recognize that the Groundwater Model produces “relative” estimates of selenium loading contributions. Therefore, it should not be interpreted to provide predictions of actual concentrations in the future, but it is useful for showing relative performance of the alternatives and highlighting key differences. Figure 4-1 shows relative model simulations for each of the remedial alternatives. For treatment, the modeling assumes that selenium concentrations in the influent treatment flow will decrease proportionally to the load at Hoopes Spring, that the system average treatment flow rate is 1,700 and 2,550 gpm, respectively, and that the treatment system selenium removal efficiency effluent will remain constant at 85% (the average value obtained in the pilot study). In addition, an evaluation of the current mass load from different springs within the Hoopes Spring complex indicates that the influent concentration would be approximately 7% lower for a 3,000 gpm system compared to the 2,000 gpm system because the additional flow would have slightly lower selenium concentrations.

As shown, covers result in a reduction in relative selenium load up to approximately 10 to 18% (capillary and geomembrane covers, respectively) in around 10 to 20 years (the groundwater travel time from the target cover areas to the springs complex). Water treatment results in an immediate and significant reduction in selenium concentrations (in the range of 40% for the 2,000 gpm treatment system and 60% for the 3,000 gpm treatment system) and will contribute to meeting the surface water standard earlier. Therefore, Alternatives SW-6a and SW-6b have a higher performance against this criterion with SW-6b having the highest performance because it has the greatest effect on reducing selenium concentrations in surface water.

<u>Compliance with ARARs</u>

The surface water standard is the same level that constitutes an unacceptable ecological risk, therefore the discussion for overall protection of the environment, above, applies to compliance with ARARs.

<u>Long-Term Effectiveness and Permanence</u>

All action alternatives provide protection of human health by covering seeps and detention ponds to prevent direct contact with surface water with arsenic concentrations greater than the MCL. The primary difference between the performance of the alternatives relative to the criterion of long-term effectiveness and permanence relates to the residual ecological risk; the treatment alternatives SW-6a and SW-6b will reduce selenium concentrations in Sage Creek and Crow Creek more quickly than the cover alternatives SW-3 (capillary cover) and SW-5 (geomembrane cover). Therefore, Alternatives SW-6a and SW-6b have a higher performance against this criterion with SW-6b having the highest performance because it has the greatest effect on reducing selenium concentrations in surface water. Covers and treatment are expected to be reliable over the long term.

Reduction of Toxicity, Mobility, and Volume through Treatment

Alternatives SW-6a and SW-6b include treatment of water discharging at Hoopes Spring and provide the highest level of performance against this criterion. Alternative SW-6a includes the existing 2,000 gpm water treatment system at Hoopes Springs, which removes approximately 40% of the selenium being transported to surface water from discharge of Wells Formation groundwater. Alternative SW-6b (a 3,000 gpm treatment system), is estimated to remove approximately 60% of the selenium being transported to surface water.

Short-Term Effectiveness

Alternatives SW-6a and SW-6b provide the highest level of short-term effectiveness because they will result in an immediate reduction in selenium concentrations in surface water in Sage Creek and Crow Creek downgradient of the springs complex and will result in a shorter time to meet water quality standards than Alternatives SW-3 and SW-5, which entail capillary and geomembrane covers on the target cover areas, respectively.

Implementability

Treatment of water discharging at the spring complex has already been implemented with the 2,000 gpm pilot Hoopes WTP (Alternative SW-6a). Expanding the facility to treat an additional 1,000 gpm could be achieved by adding a third parallel treatment train. Construction of capillary covers (Alternative SW-3) would be technically feasible and would not require specialized construction techniques or special access logistics. Simplot has installed covers using similar materials at the Smoky Canyon Mine.

Geomembrane covers (Alternative SW-5) are generally more difficult to construct than other types of covers because of potential problems related to tearing and sliding of the liner. However, geomembrane covers have been constructed locally (i.e., at the South Maybe Mine) and at other sites in the region.

Therefore, Alternatives SW-3 (capillary covers), and SW-6 (water treatment) have the highest level of performance against the implementability criterion. Alternatives SW-3 (capillary covers) and SW-5 (geomembrane covers) have a lower performance.

Cost

Alternative SW-3 entails installation of a capillary cover on the target cover areas at a present worth cost of $31 Million. Alternative SW-5 entails installation of a geomembrane cover at the same areas at a present worth cost of $70 Million. Alternative SW-6a entails continuing to operate the existing 2,000 gpm water treatment system at the Hoopes Spring, which has a present worth cost of $66 Million and SW-6b entails expanding the existing WTP to 3,000 gpm capacity, which has a present worth cost of $109 Million.

Summary

Elevated selenium concentrations in Sage Creek and Crow Creek surface water are a result of discharge of Wells Formation groundwater at the spring complex. Therefore, the discussion of the model simulations for Wells Formation groundwater described in Section 4.1 is applicable to surface water. Reductions in selenium concentrations in Wells Formation groundwater are expected to occur over the next 10 to 20 years as a result of the migration of selenium associated with active mining and the effects of the Pole Canyon NTCRAs and over the next 50 to 100 years as a result of the source depletion.

On a relative perspective, water treatment at Hoopes Spring provides immediate reductions of selenium concentrations in surface water in Sage Creek and Crow Creek. Covers provide a reduction of selenium load over a longer time period (10 to 20 years; the groundwater travel times from the target cover areas to the spring complex).

Based on the Conceptual Site Model and understanding the limitations of the modeling, Alternative SW-6a (2,000 gpm water treatment at Hoopes Spring) provides the best performance against the evaluation criteria and is recommended for selection as part of the Site remedy. It provides significant selenium removal and is more cost-effective than Alternative SW-6b (3,000 gpm water treatment at Hoopes Spring). It is recommended that Alternative SW-3 (installing a capillary cover at the target cover areas on Panels D and E) also be selected. It provides additional source control compared to current conditions at a relatively moderate cost. Long-term surface water monitoring will allow for an evaluation of whether the reductions in selenium occur more quickly or more slowly than the model indicates. In the event that surface water improvements occur more slowly than expected, additional actions could be considered and selected as part of the 5-year review process.

4.3 Alluvial Groundwater

The remedial alternatives evaluated in the detailed analysis were as follows:

- Alternative AG-1 – No Further Action
- Alternative AG-3 – Institutional Controls
- Alternative AG-5 – Permeable Barrier Reactor and ICs

Overall Protection of Human Health and Environment

Alternative AG-1, the No Further Action alternative would not be protective of human health. There are no significant differences between remedial alternatives AG-3 and AG-5 in terms of overall protection of human health and the environment. All action alternatives provide protection of human health by placing deed restrictions on Simplot's land in Sage Valley to prevent use of groundwater with selenium concentrations above the MCL as a domestic water supply. There are no environmental risks associated with alluvial groundwater.

Compliance with ARARs

Selenium concentrations are above the MCL in alluvial groundwater in Pole Canyon (about 2 mg/L at GW-26), reduce to 0.025 to 0.14 mg/L at the mouth of Pole Canyon (GW-15) and are in the range of 0.1 mg/L downgradient in Sage Valley (GW-22). The Pole Canyon 2013 NTCRA has resulted in a reduction in selenium concentrations. In addition, source term modeling indicates that the rate of release of selenium from the Pole Canyon ODA will decrease over time, such that selenium mass flux and concentrations in the alluvial aquifer are also expected to decline. Therefore, it is anticipated that without additional action (i.e., Alternative AG-3) selenium concentrations will be below MCLs in alluvial groundwater outside Pole Canyon within a relatively short timeframe (of the order of a decade). Construction of a PRB at the LP-1 seep (Alternative AG-5) is estimated to remove approximately 75% of the selenium transported in alluvial groundwater, which is expected to reduce as a result of the NTCRAs. This would reduce selenium concentrations in alluvial groundwater outside Pole Canyon to below the MCL within a year, but concentrations would still be above the MCL in Pole Canyon (on the order of 0.5 mg/L at GW-26, assuming load reduction is equivalent to concentration reduction).

Long-Term Effectiveness and Permanence

There are no significant differences between Alternatives AG-3 and AG-5 in terms of long-term effectiveness and permanence. All action alternatives provide protection of human health by placing deed restrictions on Simplot's land in Sage Valley to prevent use of groundwater with selenium concentrations above the MCL as a domestic water supply. The magnitude of residual risk after response actions have been met is similar under Alternatives AG-3 and AG-5: the area with selenium concentrations greater than the MCL is estimated to be similar over the long term.

Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative AG-5 has the highest performance against this criterion because it includes a PRB to treat toe seep water at LP-1. This is predicted to remove approximately 75% of the selenium transported in alluvial groundwater downgradient of the Pole Canyon ODA. Alternative AG-3 does not have a treatment component.

Short-Term Effectiveness

There are no significant differences between the remedial alternatives in terms of short-term effectiveness. Alternatives AG-3 and AG-5 would be protective of the community during remedial actions and environmental impacts would be minimal. There would be an increase in risk to workers for Alternative AG-5 during the construction of the PRB. While Alternative AG-5 would reduce selenium concentrations in portions of the alluvial groundwater more quickly, it would not reduce selenium concentrations in Pole Canyon to below the MCL. Alternative AG-3 achieves the same areal reduction in approximately 10 years. ICs protect human health in the interim.

Implementability

There is no significant difference between the remedial alternatives in terms of implementability. Institutional controls (Alternative AG-3) are readily implementable on Simplot-owned land in Sage Valley. Alternative AG-5 (PRB) is implementable using standard construction methods and materials and there are no administrative obstacles.

Cost

Alternative AG-3 uses ICs to provide protection in the period when selenium concentrations remain above MCLs in alluvial groundwater on Simplot-owned land in Sage Valley and is the most inexpensive of the remedial alternatives for alluvial groundwater at a present value cost of $446,900. Alternative AG-5 includes a PRB at the toe of the Pole Canyon ODA at a present value cost of $2 Million.

Summary

Human health is immediately protected by ICs by placing deed restrictions on Simplot's land in Sage Valley to prevent use of groundwater with selenium concentrations above the MCL as a domestic water supply. There are no environmental risks associated with alluvial groundwater.

Selenium concentrations in alluvial groundwater have reduced as a result of the Pole Canyon 2013 NTCRA and continued reductions are anticipated. As such under Alternative AG-3 (Institutional Controls) selenium concentrations are anticipated to reduce below MCLs except in

Pole Canyon within about a decade. Construction of a PRB would have the same effect but within a year and at a present worth cost of $2 Million. Because human health and the environment are protected immediately and concentrations are expected to reduce over time, Alternative AG-3 (Institutional Controls) is most cost effective and is recommended for selection as part of the Site remedy.

4.4 Soils and Solids

The remedial alternatives for soils and solids evaluated in the detailed analysis were as follows:

- Alternative S-1 – No Further Action
- Alternative S-2 – Rock Covers on Soils in Seep and Riparian Areas
- Alternative S-3 – 2-Foot-Thick Dinwoody or Salt Lake Formation Covers on Uncovered Areas of ODAs and Rock Covers on Soils in Seep and Riparian Areas

<u>Overall Protection of Human Health and Environment</u>

There are two issues related to soils: (1) risks to ecological receptors (i.e., deer mice and bird populations) from exposure to selenium due to ingestion of soil, vegetation, and invertebrates on uncovered overburden and in seep and riparian areas; and; (2) risks to seasonal ranchers from exposure to arsenic, primarily due to ingestion of beef from cattle grazed at the Site.

For deer mice calculated HQs for Alternative S-1 No Further Action (i.e., current conditions) are above 1 for all ODAs except for the Pole Canyon ODA. Panels B, C and E, which have complete Dinwoody covers (over areas where mining activities have been completed at Panel B; areas remain to be filled with overburden) have estimated HQs between 1.4 and 2.8 (95UCL mean selenium concentrations are estimated at 1.5 to 4.2 mg/kg). Panel A, which has Dinwoody covers in some areas has an estimated HQ of 5.8 (95 UCL mean selenium concentration 11.4 mg/kg) and Panel D, which has a chert cover in some areas has an HQ of 7.6 (95UCL mean selenium concentration 16.3 mg/kg). The Site-wide HQ is 3.9. Installing a 2-foot-thick cover on uncovered areas of ODAs (i.e., Panel D and areas of Panel A) would reduce HQs on all panels into the 1.4 to 2.8 range (95 UCL mean selenium concentration 1.5 to 4.2 mg/kg). These calculations are for overburden areas only. Covering of seep and riparian areas (Alternatives S-2 and S-3) would prevent exposure to selenium in soils at these locations.

It is unlikely that there are risks to small mammal populations for current overburden conditions based on the data collected at the Conda Mine specifically to assess the effects of selenium concentrations in exposed mining materials on small mammal populations. The soils within the Conda small mammal population study sites were sampled in 2019 to determine the concentrations of selenium to which the small mammals inhabiting those areas were exposed and the effect on populations. The Conda selenium concentrations at the small mammal population study sites ranged from 58.8 to 134 mg/kg with 95UCL mean concentration of 102 mg/kg. These represent soil selenium concentrations at which no significant effects to small mammal population density and abundance were observed. The highest 95UCL mean selenium concentration measured at Smoky Canyon is 16.3 mg/kg at Panel D. This concentration is considerably lower than the lowest concentration measured in the Conda study (58.8 mg/kg), and based on the study at Conda, there is high confidence of a low likelihood of effects on the abundance/density of small mammals due to exposure to selenium at Smoky Canyon Mine.

The PRG for bird populations is compared to the UCL mean selenium concentration in soil related to ODAs on a Site-wide basis. Using the available data, the calculated value for current conditions (No Further Action) is 7 mg/kg. The calculated concentration corresponds to a HQ of 2.9 using the TRVs for birds presented in in the SSERA. For Alternative S-3, the calculated HQ is 1 for bird populations.

Since the completion of the SSERA, NuWest Inc. has developed a set of selenium TRVs for bird receptors based on dietary modelling to egg-based selenium effects levels (Arcadis 2018). These TRVs represent a good estimate of risk to bird receptors because they are based on the measures of reproductive effects specifically caused by selenium in birds (i.e. egg hatchability). When compared to the SSERA TRVs, which were derived using generic TRV derivation techniques not specifically based on the primary mode of action for selenium, the NuWest TRVs likely provide a better estimate of potential toxicity to bird populations. The NuWest LOAEL TRV (3.0 mg/kg BW/day) is approximately five-times higher than the geometric mean NOAEL TRV (0.61 mg/kg BW/day) used to calculate the bird PRG. By extension, the HQ corresponding with the bird PRG would also be approximately five-times lower if the NuWest TRV were used in its calculation (i.e. below 1). Therefore, bird populations are not likely to be adversely affected at Smoky Canyon due to exposure to selenium under current conditions.

The PRG for arsenic in soil to protect future seasonal ranchers is compared to the 95UCL of the mean concentration on a Site-wide basis, which is estimated at 10.2 mg/kg; below the PRG of 11.5 mg/kg. Therefore, the PRG is met under current conditions and human health is protected under current conditions.

Compliance with ARARs

There are no ARARs for soils.

Long-Term Effectiveness and Permanence

There are no significant differences between the remedial alternatives in terms of long-term effectiveness and permanence. All alternatives provide protection of human health and the environment and the magnitude of residual risk is similar under both action alternatives.

Reduction of Toxicity, Mobility, and Volume through Treatment

None of the remedial alternatives include treatment and therefore there is no difference in performance against this criterion.

Short-Term Effectiveness

Alternative S-2 performs the highest against the short-term effectiveness criterion. Alternative S-3 would entail higher risks to workers during construction of covers. RAOs are met immediately by both Alternatives S-2 and S-3.

Implementability

There is no significant difference between the remedial alternatives in terms of implementability. All alternatives are implementable using standard construction methods and materials and there are no administrative obstacles.

Cost

Alternative S-2 entails installation of rock covers on seep and riparian areas at a present worth cost of $256,000. Alternative S-3 entails covering all uncovered areas (at Panel A and Panel D) with a 2-foot-thick Dinwoody cover at a present worth cost of $20 Million.

Summary

Protection of human health and the environment is achieved under current conditions for overburden (i.e., Alternative S-1 No Further Action). Covering seep and riparian areas (Alternative S-2) would prevent exposure to selenium at those areas. Constructing a 2-foot-thick Dinwoody cover on uncovered areas of Panels A and D (Alternative S-3) would reduce selenium concentrations in surface soils at a cost of $20 Million and would not be cost effective. Alternative S-2 would involve construction of rock covers on soils in seep and riparian areas and is protective of deer mice and birds and is recommended for selection as part of the Site remedy.

5.0 RECOMMENDED SITE-WIDE REMEDY

The results of the detailed and comparative analysis serve to highlight the relative advantages and disadvantages of each alternative and provide the basis for identifying the combination of media-specific alternatives recommended as the preferred Site-wide remedy for the Smoky Canyon Mine. The recommended Site-wide remedy is shown on Figure 5-1 and includes the following media-specific alternatives:

- Wells Formation Groundwater Alternative WG-5 – Capillary Covers and Institutional Controls (Deed Restrictions)
- Surface Water Alternative SW-3 – Capillary Covers
- Surface Water Alternative SW-6a – Treatment of Water Discharging at Hoopes Spring (2,000 gpm system)
- Alluvial Groundwater Alternative AG-3 – Institutional Controls (Deed Restrictions)
- Solids and Soil Alternative S-2 – Rock Covers on Soils in Seep and Riparian Areas.

The total present worth cost of the recommended Site-wide remedy is $98.3 Million. This is in addition to the $11.2 Million already expended on the Pole Canyon NTCRAs.

The primary issue to be addressed at the Site is the release of selenium from overburden to Wells Formation groundwater (resulting in concentrations above the MCL) and migration of the groundwater and discharge to surface water at Hoopes Spring and South Fork Sage Creek springs (resulting in concentrations in surface water in Sage Creek and Crow Creek above the water quality standard). The rate of selenium release after mining depends on location specific conditions; primarily the setting, areal extent of the overburden and the cover placed on it. The relative magnitude of selenium loading to Wells Formation groundwater is proportional to net infiltration rates through overburden. In addition, the timing of any effect on selenium load discharging at the springs depends on the distance from the overburden to the springs. Simplot evaluated Site conditions and identified 3 areas that are primary candidates for covers: Panels D-1, and E-1n and the D Panel external ODA, which are collectively termed the “target cover areas” in this report. These areas are estimated to have relatively high net infiltration rates through overburden and are close to the springs such that effects of covers would be realized in a relatively short timeframe (for example, compared to Panel A, which is estimated to have a groundwater travel time to the springs of 25 to 30 years).

Selenium concentrations in Wells Formation groundwater are decreasing in key areas and are anticipated to continue to decrease in the future as a result of four factors: (1) the reduction of load that originated from active mining (for example shown at GW-25, downgradient of Panel E); (2) the effect of post-mining reclamation (i.e., covers) and other water controls implemented by Simplot (also shown at GW-25); (3) the reduction of load from the Pole Canyon ODA as a result of the NTCRAs (shown at GW-16); and (4) the depletion of the selenium source for the ODAs over time (as indicated by Site-specific column leach tests and estimated infiltration rates through overburden covers performed under NEPA).

As the load of selenium in Wells Formation groundwater decreases it is expected to result in a general reduction in selenium concentrations in groundwater, with specific effects being dependent on the physical location of the well screen relative to source areas and groundwater flow paths. Over time this will result in decreases of mass flux of selenium discharging to surface water at Hoopes Spring and South Fork Sage Creek springs, with a corresponding reduction in in selenium concentrations in Sage Creek and Crow Creek. Reductions in selenium mass flux at the springs are predicted to occur over the next 10 to 20 years as a result of the migration of selenium associated with active mining, post-mining reclamation and water controls, and the effects of the Pole Canyon NTCRAs and over the next 50 to 100 years as a result of source depletion. While groundwater and surface water conditions are expected to improve over time, it is uncertain whether selenium concentrations will ultimately reduce to below the standards at all monitoring locations.

A key component of the recommended Site-wide remedy is treatment of water discharging at Hoopes Spring (Alternative SW-6a) by continuing operation of the existing 2,000 gpm WTP. This is resulting in a reduction of selenium concentrations in Sage Creek and Crow Creek by approximately 40%. In the existing system, spring water with elevated selenium concentrations is pumped from stations located at Hoopes Spring and South Fork Sage Creek springs to the Hoopes WTP. The treatment system uses two treatment trains, which consist of UF to remove particulate material and RO and FBRs to remove selenium, at a maximum design flow rate of approximately 2,000 gpm. Polishing steps used in the existing treatment system include aeration, clarification, and sand filtration. The FBR effluent is treated using an activated sludge post-treatment system prior to discharge to the outfall. Treated water is discharged back to the main stem of Hoopes Spring via the riprap-lined outfall channel north of the treatment building. Sludge generated from the post-treatment system is trucked to a Subtitle D landfill for disposal.

As a result of post-mining reclamation and the 2013 Pole Canyon NTCRA, Simplot has already placed a cover over approximately 1,060 of the 1,422 acres of overburden present at the Site (75%). Covering additional areas will provide incremental benefit by reducing selenium load to the Wells Formation and ultimately reducing the selenium load discharging to surface water at the spring complex (in approximately 10 to 20 years; the estimated transport time from the target cover areas to the spring complex).

Therefore, additional cover is recommended at the target cover areas to further reduce selenium loading to Wells Formation groundwater and ultimately to surface water (Alternatives WG-5 and SW-3, which both have the same type of cover). Capillary covers would be constructed on target cover areas at Panels D and E. The current capillary cover concept is that it would consist of 2-feet of uncompacted Dinwoody or Salt Lake Formation material, a layer of filter fabric and 12-inches of screened chert/limestone over a working base layer of graded Dinwoody or Salt Lake Formation (Figure 2-9) on top of graded overburden. It would also include drainage benches to remove water off the cover at spacings of approximately 150 feet (dependent on slope; closer spacing for flatter slopes). Target cover areas could be graded as necessary for cover construction. The cover would be vegetated with native grass/forb species to control erosion. Storm water run-on and runoff controls would be constructed as part of the cover system (Alternatives WG-5 and SW-3) to convey water off or around the ODAs. These controls would consist of a combination of channels, spillways, sedimentation basins, and infiltration basins. This is a relatively new cover concept that would require analysis during remedial design to assess the effectiveness of the components relative to specific material properties and conditions at the Site.

The extensive ODA covers already constructed at the Site provide protection for human health and the environment (i.e., small mammals and birds) for soils. Rock covers would be placed as a physical barrier layer on seeps (DS-7 and LP-1) and detention ponds (DP-7 and EP-2) to prevent direct contact with surface water with arsenic concentrations greater than the MCL. Rock covers would be placed on overburden seep and riparian areas (DS-7, ES-4, and LP-1) to prevent small mammals and birds from contacting or ingesting soil with elevated selenium concentrations. Chert, limestone, or other rock material available from active mining operations would be used as cover materials. Fences and signs to notify people that the surface water should not be consumed may be installed at DP-7, DS-7, EP-2, and LP-1 in the interim to prevent contact.

Deed restrictions on Simplot-owned land in Sage Valley would be put in place to prevent the use of Wells Formation and alluvial groundwater with selenium concentrations greater than the MCL as a source of drinking water (Alternatives WG-5 and AG-3, respectively). Specific performance objectives (e.g., prevent access or use of Wells Formation groundwater and/or alluvial groundwater until cleanup levels are met) would be included in the ROD and then specified as restrictions on the property deed. An ICIAP would be prepared to specify how the deed restrictions will be implemented, maintained, enforced, modified, and terminated (if applicable). Deed restrictions would only be applied to areas where selenium concentrations exceed the MCL and would be ultimately be removed when the MCL is met throughout Simplot-owned land in Sage Valley.

O&M and groundwater and surface water monitoring for the 2006 and 2013 NTCRAs at the Pole Canyon ODA would continue as per the existing Settlement Agreements. Inspections of the bypass pipeline (including inlet and outlet structures), sedimentation basin and infiltration basin, and run-on control channel for the 2006 NTCRA, and inspections of the Dinwoody/chert cover system and access roads, drainage control features, sedimentation basins, and reclaimed borrow area for the 2013 NTCRA would be performed semiannually. Maintenance activities would be performed annually, as needed.

Periodic O&M would be required for the capillary covers installed at the target areas on Panel D and Panel E (Alternatives WG-5 and SW-3) to ensure the integrity and permanence of the cover system and other components. The capillary covers may require periodic O&M to maintain their integrity. Ditches for the storm water control system may require clearing of vegetation or debris. The actual O&M objectives and maintenance requirements would be established during the remedial design process for the Site-wide remedy.

Routine O&M of the treatment system (Alternative SW-6a) entails flow adjustment, chemical selection and dose rates, system-optimization monitoring, and maintenance operations, and would be ongoing as the Hoopes WTP continues operation. Monitoring of influent and effluent water streams is conducted to provide the information needed to optimize the operation and performance of the treatment system.

Long-term groundwater and surface water monitoring would be required to evaluate the effectiveness of the Site-wide remedy at Smoky Canyon Mine. The groundwater and surface water monitoring network would likely consist of existing monitoring wells in Pole Canyon and downgradient in Sage Valley, and surface water sampling locations at Hoopes Spring and South Fork Sage Creek springs and downstream in Sage Creek and Crow Creek. The actual long-term monitoring objectives and locations and frequencies would be established during the remedial design process. Results of the long-term monitoring would be used to support the protectiveness evaluations during the CERCLA 5-year review process.

6.0 REFERENCES

Arcadis. 2017. Draft Baseline Ecological Risk Assessment. Champ Mine Site. Caribou County, Idaho. Appendix L. Mammal Community Risk Assessment.

Arcadis. 2018. Draft Baseline Ecological Risk Assessment. North Maybe Mine East Mill Operable Unit, Open-Pit Sub-Operable Unit, and South Maybe Canyon Mine Open Pits Operable Unit. Prepared for Nu-West Industries, Inc./Nu-West Mining, Inc. April 2.

Benson, C.H. 2019. Field Hydrology of the Simple 1 and GCLL Final Cover Test Sections for the East Overburden Pit and the North Pit, Blackfoot Bridge Mine: Annual Report for Calendar Year 2018. 10 May 2019.

Bureau of Land Management and U.S. Department of Agriculture Forest Service (BLM and USFS). 2002. Final Supplemental Environmental Impact Statement (SEIS), Smoky Canyon Mine Panels B and C. Prepared by JBR Environmental Consultants, Inc., Sandy, UT. BLM, Pocatello Field Office, Pocatello, ID. USFS, Caribou-Targhee National Forest. April 2002.

Formation Environmental LLC (Formation). 2014a. Final Smoky Canyon Mine Remedial Investigation/Feasibility Study Remedial Investigation Report. Prepared for J.R. Simplot Company, Afton, Wyoming and Boise, Idaho. September.

Formation. 2014b. Final Pilot Study Work Plan and Sampling and Analysis Plan, (Phase 1) Biological Selenium Removal Treatment Technology Fluidized Bed Bioreactor, and subsequent Addenda 01 through 04. Smoky Canyon Mine. Prepared for the J.R. Simplot Company. September.

Formation. 2015. Final Site-Specific Ecological Risk Assessment Report, Smoky Canyon Mine Remedial Investigation/Feasibility Study. Prepared for J.R. Simplot. December.

Formation. 2016. Final Site-Specific Ecological Risk Assessment Report for Conda/Woodall Mountain Mine Superfund Remedial Investigation/Feasibility Study. Prepared for J.R. Simplot Company. December.

Formation. 2017. Final Phase 2 Pilot Study Work Plan and Sampling and Analysis Plan, Ultra-Filtration/Reverse Osmosis and Biological Selenium Removal Fluidized Bed Bioreactor Treatment Technology, Smoky Canyon Mine Remedial Investigation/Feasibility Study. Prepared for J.R Simplot Company. March.

Formation. 2018. Final Conda/Woodall Mountain Mine Small Mammal Survey Year 3 (2017) Data Summary Report. Prepared for J.R. Simplot Company, June.

Formation. 2019a. Draft 2018 Annual Pole Canyon Non-Time-Critical Removal Actions Performance and Effectiveness Monitoring Report, Smoky Canyon Mine. Prepared for J.R. Simplot Company. July.

Formation. 2019b. July 2019 Groundwater and Surface Water Monitoring Study Field-Scale Permeable Reactive Barrier Pilot Study. Conda/Woodall Mountain Mine. Prepared for J.R. Simplot Company. September.

Formation. 2019c. Final Feasibility Study Technical Memorandum #1: Identification and Screening of Remedial Technologies. Smoky Canyon Mine RI/FS. Prepared for J.R. Simplot Company. December.

Formation. 2019d. Draft 2018 Annual Report Pole Canyon Non-Time-Critical Removal Action Performance and Effectiveness Monitoring, Smoky Canyon Mine. Prepared for J.R. Simplot Company. July.

Formation. 2020. Draft Removal Action Report, Pole Canyon Overburden Disposal Area 2013 Non-Time-Critical Removal Action, Smoky Canyon Mine. Prepared for J.R. Simplot Company. February.

Hay, M., G. Leone, F. Partey, B. Wilking (Hay et al.). 2016. Selenium attenuation via reductive precipitation in unsaturated waste rock as a control on groundwater impacts in the Idaho phosphate patch, *J. Applied. Geochemistry*., 74, 176-193.

HydroGeo Group, LLC (HCG). 2018. Final Technical Memorandum East Smoky Panel of the Smoky Canyon Mine Numerical Modeling Report. March.

JBR Environmental Consultants, Inc. (JBR), 2007. Groundwater Flow and Solute Transport Modeling Report, Smoky Canyon Mine, Panels F and G Extension Area.

NewFields Boulder LLC (NewFields). 2005. Final Site Investigation Report for Smoky Canyon Mine – Area A, Caribou County, Idaho. Prepared for J.R. Simplot Company, July.

Ohlendorf H.M. 1989. Bioaccumulation and effects of selenium in wildlife. In Jacobs LW, editor, Selenium in agriculture and the environment. Special publication 23. Madison (WI, USA): *American Society of Agronomy and Soil Science Society of America*. p 133–177.

O'Kane Consultants. 2019. Smoky Canyon Mine "F" and "G" Panels Expansion – Deep Dinwoody Cover System Field Performance Trial 2018 Annual Performance Monitoring Report. Prepared for Simplot – Smoky Canyon Mine. January.

Page C., and S.A. Ritter. 1999. Birds in a sagebrush sea: Managing sagebrush habitats for bird communities. Partners in Flight, Western Working Group. Boise, ID.

Reed, J.M. 1985. A comparison of the "flush" and spot-map methods for estimating the size of Vesper Sparrow territories. *J. Field Ornithol*. 56:131-137.

Reed, J.M. 1986. Vegetation structure and Vesper Sparrow territory location. *Wilson Bull*. 98:144-147.

Reed D.H., O'Grady J.J., Brook B.W., Ballou J.D., and Frankham R. (Reed et al.). 2003. Estimates of minimum viable es for vertebrates and factors influencing those estimates. *Biol. Conserv*. 113:23-33.

Schaid, T.A., D.W. Uresk, W.L. Tucher and R.L. Linder. 1983. Effects of surface mining on the Vesper Sparrow in the northern Great Plains. *J. Range Manage*. No. 36:500-503.

J.R. Simplot Company (Simplot). 2018. Dinwoody Material Source Investigation Report. Prepared by Katie Wilkes, J.R. Simplot Company. November 27, 2018.

Tetra Tech. 2008. Geochemical Characterization of Phosphate Mining Overburden, Characterization of Solids and Vapor Composition in Overburden Disposal Facilities with Implications for Weathering and Selenium Release, prepared for the Idaho Phosphate Working Group, February.

Thomas, C.D. 1990. What do real population dynamics tell us about minimum viable population sizes? *Cons. Biology*. 4(3):324-327.

United States Department of Agriculture Forest Service (USFS). 2017. Agency comments on the Smoky Canyon Mine RI/FS Revised Draft Tech Memo #1, dated March 16, 2017. Letter from Arthur Burbank (USFS) to Alan Prouty (Simplot). September 8, 2017.

USFS. 2019. Approval of the Smoky Canyon Mine RI/FS Revised Technical Memorandum #1, dated October 2019. Letter from Arthur Burbank (USFS) to Alan Prouty (Simplot). December 4, 2019.

United States Department of Agriculture, Forest Service Region 4, Idaho Department of Environmental Quality, Shoshone-Bannock Tribes (USFS, IDEQ, and Tribes). 2013. Administrative Settlement Agreement and Order on Consent/Consent Order for Non-Time-Critical Removal Action, Smoky Canyon Phosphate Mine. J.R. Simplot Company Respondent. Signed November 27, 2013.

United States Department of Agriculture, Forest Service Region 4, United States Environmental Protection Agency, Region 10, Idaho Department of Environmental Quality (USFS, USEPA, and IDEQ). 2006. Administrative Settlement Agreement and Order on Consent/Consent Order for Non-Time-Critical Removal Action, Smoky Canyon Phosphate Mine. J.R. Simplot Company Respondent. Signed October 2, 2006.

USFS, USEPA, and IDEQ. 2009. Administrative Settlement Agreement and Order on Consent/Consent Order for Remedial Investigation/Feasibility Study, Smoky Canyon Phosphate Mine, J.R. Simplot Company Respondent. Signed August 13, 2009.

USFS et al. 2011. Evaluation of the Transport and Persistence of Selenium in Wells Formation Groundwater at the Smoky Canyon Mine. Provided to J.R. Simplot Company with Agency Comments (dated October 7, 2011) on the Draft 2010 Annual Effectiveness Monitoring Report for the Pole Canyon Removal Action (dated August 19, 2011).

United States Environmental Protection Agency (USEPA). 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. Interim Final. EPA/540/G-89/004. OSWER 9355.3-01. October.

USEPA. 2003. Five-Year Review Process in the Superfund Program. EPA/540-F-02-004, OSWER 9355.7-09FS. April.

USEPA. 2004. Draft Technical Guidance for RCRA/CERCLA Final Covers. United States Environmental Protection Agency Office of Solid Waste and Emergency Response. EPA 540-R-04-007. April.

USEPA. 2012. Institutional Controls: A Guide to Preparing Institutional Control Implementation and Assurance Plans at Contaminated Site. EPA-540-R-09-002. OSWER 9200.0-77. December.

TABLES

TABLE 2-1. Technologies Retained in FSTM#1 by Media

	Groundwater	Surface Water	Solids and Soils
No Action			
No Further Action	X	X	X
Institutional Controls (ICs)			
Land-Use Restrictions / Grazing Controls			X
Deed Restrictions	X		
Information Programs			X
Access Controls			
Signs		X	
Fences / Gates		X	X
Engineered Covers			
Chert / Limestone Cover	X	X	X
Dinwoody Cover	X	X	X
Geosynthetic Cover	X	X	
Sediment Control Features			
Dikes and Berms		X	
Detention Basins		X	
Surface Controls			
Grading / Erosion Control			X
Vegetation			X
Slope Stabilization			
Slope Reduction / Retaining Walls			X
Diversion			
Open / Closed Channels	X	X	
Removal [1]			
Excavation			X
Disposal [1]			
Onsite Consolidation/ Disposal			X
Offsite Disposal			X
Discharge to Onsite Treatment or Other Disposal Facility		X	
Ex-Situ Treatment [2]			
Gravity / Mechanical Separation	X		
Media Filtration	X		
Ultrafiltration/Reverse Osmosis	X		
Biodegradation	X		
In-Situ Treatment			
Biodegradation		X	
Natural Treatment			
Monitored Natural Attenuation (MNA)	X		

Notes:

1 - Retained for small volumes of sediment and/or treatment residuals (solids and soils).

2 - Ex-situ treatment technologies retained in FSTM#1 for groundwater were based on the Hoopes Water Treatment Plant (WTP) Pilot Study, which treats Wells Formation groundwater that discharges at the springs complex. In FSTM#2, the spring discharge is considered surface water, not groundwater.

TABLE 2-2. Screening Evaluation of Remedial Alternatives for Wells Formation Groundwater

	Alternative WG-1 No Further Action	Alternative WG-2 Monitored Natural Attenuation (MNA)	Alternative WG-3 Institutional Controls (ICs)	Alternative WG-4 5-Foot Dinwoody or Salt Lake Formation/Chert Covers, ICs and MNA	Alternative WG-5 Capillary Covers, ICs and MNA	Alternative WG-6 Enhanced Dinwoody Covers, ICs and MNA	Alternative WG-7 Geomembrane Covers, ICs and MNA
Components	No additional actions	MNA of Wells Formation groundwater Long-term groundwater monitoring	ICs (deed restrictions)	5-Foot Dinwoody or Salt Lake Formation/chert covers Storm water run-on/runoff controls ICs (deed restrictions) MNA of Wells Formation groundwater O&M and groundwater monitoring	Capillary covers Storm water run-on/runoff controls ICs (deed restrictions) MNA of Wells Formation groundwater O&M and groundwater monitoring	Enhanced Dinwoody covers Storm water run-on/runoff controls ICs (deed restrictions) MNA of Wells Formation groundwater O&M and groundwater monitoring	Geomembrane covers Stormwater run-on/runoff controls ICs (deed restrictions) MNA of Wells Formation groundwater O&M and groundwater monitoring
Effectiveness	**Low**	**Low**	**Moderate**	**Moderate to High**	**Moderate to High**	**Moderate to High**	**Moderate to High**
Protection of Human Health and the Environment	Human health would not be protected because groundwater with selenium concentrations above the MCL could be used as a source of drinking water on Simplot-owned land in Sage Valley in the future. There are no environmental risks associated with Wells Formation groundwater.	Same as Alternative WG-1.	Human health would be protected because ICs (deed restrictions) would prevent the use of Wells Formation groundwater with selenium concentrations above the MCL as a source of drinking water. There are no environmental risks associated with Wells Formation groundwater.	Same as Alternative WG-3.	Same as Alternative WG-3.	Same as Alternative WG-3.	Same as Alternative WG-3.
Compliance With ARARs	No additional actions would be implemented. The Groundwater Model estimates that mass flux of selenium from the ODAs to Wells Formation groundwater will reduce over time. This is expected to result in a general reduction in selenium concentrations in groundwater, with specific effects being dependent on the physical location of the well screen relative to source areas and groundwater flow paths. While groundwater conditions are expected to improve over time, it is uncertain whether selenium concentrations will ultimately reduce to below the MCL at all monitoring locations over the long term.	Although local column tests suggested that MNA processes are not currently having a significant effect on selenium mass flux (and concentrations) in Wells Formation groundwater, conditions in waste rock within pit backfill and external ODAs are variable and may become less oxic over time, which could affect groundwater conditions. Therefore, natural attenuation may be effective and may result in a reduction of selenium concentrations over time.	The same reduction of selenium concentrations would occur over time as for Alternative WG-1.	Installing a Dinwoody or Salt Lake Formation/chert cover is estimated to reduce the infiltration for an average precipitation year by 29%. This would lead to a similar reduction of selenium releases at the target cover areas and would be expected to reduce selenium concentrations in Wells Formation groundwater in the vicinity in addition to reduction predicted to occur without action (Alternative WG-1).	Installing a capillary cover is estimated to reduce the infiltration of water for an average precipitation year by 58%. This would lead to a similar reduction of selenium releases at the target cover areas and would be expected to reduce selenium concentrations in Wells Formation groundwater in the vicinity in addition to reduction predicted to occur without additional action. MNA would be the same as described under Alternative WG-2.	Installing an Enhanced Dinwoody cover is estimated to reduce the infiltration of water for an average precipitation year by 95%. This would lead to a similar reduction of selenium releases at the target cover areas and would be expected to reduce selenium concentrations in Wells Formation groundwater in the vicinity, in addition to reductions predicted to occur without additional action. MNA would be the same as described under Alternative WG-2.	Installing geomembrane covers is estimated to reduce the infiltration of water for an average precipitation year by 100% in the short term. This would lead to a similar reduction of selenium releases at the target cover areas and would be expected to reduce selenium concentrations in Wells Formation groundwater in the vicinity, in addition to reductions predicted to occur without additional action. MNA would be the same as described under Alternative WG-2.
Long Term Effectiveness and Permanence	No additional actions would be implemented. Mass flux of selenium from the ODAs to Wells Formation groundwater will reduce over time. This is expected to result in a general reduction in selenium concentrations in groundwater. Human health would not be protected because groundwater with selenium concentrations above the MCL could still be used as a source of drinking water in the future.	The effectiveness of MNA depends on source-control remedies and aquifer conditions (i.e., anoxic or low-oxygen conditions). Site data indicate that MNA is not having a significant effect on selenium concentrations in Wells Formation groundwater, conditions in waste rock within pit backfill and external ODAs are variable and may become less oxic over time. Therefore, natural attenuation may be effective and may result in a reduction of selenium concentrations over time. Human health would not be protected because groundwater with selenium concentrations above the MCL could still be used as a source of drinking water in the future. Long-term groundwater monitoring would be required to assess the progress of the natural attenuation in Wells Formation groundwater.	ICs (deed restrictions) would be effective in preventing the extraction and use of Wells Formation groundwater with selenium concentrations above the MCL as a source of drinking water. Deed restrictions would only be applied to areas where selenium concentrations exceed the MCL and would be ultimately be removed when the MCL is met throughout Simplot-owned land in Sage Valley.	ICs (deed restrictions) would be effective in preventing the extraction and use of Wells Formation groundwater with selenium concentrations above the MCL as a source of drinking water. Deed restrictions would only be applied to areas where selenium concentrations exceed the MCL and would be ultimately be removed when the MCL is met throughout Simplot-owned land in Sage Valley. A Dinwoody or Salt Lake Formation/chert cover would reduce infiltration into the underlying overburden material, and subsequent migration of selenium into Wells Formation groundwater over the long term. MNA would be the same as described under Alternative WG-2. O&M and groundwater monitoring would be required to monitor the performance and effectiveness of the covers.	Same as Alternative WG-4.	Same as Alternative WG-4.	ICs (deed restrictions) would be effective in preventing the extraction and use of Wells Formation groundwater with selenium concentrations above the MCL as a source of drinking water. Deed restrictions would only be applied to areas where selenium concentrations exceed the MCL and would be ultimately be removed when the MCL is met throughout Simplot owned land in Sage Valley. The geomembrane cover would reduce infiltration into the underlying overburden material, and subsequent migration of selenium into Wells Formation groundwater over the short term. However, the geosynthetic materials have a finite life expectancy because they are composed of man-made materials. MNA would be the same as described under Alternative WG-2. O&M and groundwater monitoring would be required to monitor the performance and effectiveness of the covers.
Reduction of Toxicity, Mobility, or Volume Through Treatment	No treatment would be implemented.	Significant selenium attenuation has not been observed.	No treatment would be implemented.	No treatment would be implemented.	No treatment would be implemented.	No treatment would be implemented.	No treatment would be implemented.

TABLE 2-2. Screening Evaluation of Remedial Alternatives for Wells Formation Groundwater

	Alternative WG-1 No Further Action	Alternative WG-2 Monitored Natural Attenuation (MNA)	Alternative WG-3 Institutional Controls (ICs)	Alternative WG-4 5-Foot Dinwoody or Salt Lake Formation/Chert Covers, ICs and MNA	Alternative WG-5 Capillary Covers, ICs and MNA	Alternative WG-6 Enhanced Dinwoody Covers, ICs and MNA	Alternative WG-7 Geomembrane Covers, ICs and MNA
Short-Term Effectiveness	No additional actions would be implemented.	Same as Alternative WG-1.	No additional actions would be implemented. ICs to restrict consumptive use of contaminated Wells Formation groundwater would be effective immediately.	Risk of construction worker exposure to overburden material during remedial construction activities would be mitigated using standard health and safety protocols. Remedial construction workers would wear appropriate PPE. ICs to restrict consumptive use of contaminated Wells Formation groundwater would be effective immediately.	Same as Alternative WG-4.	Same as Alternative WG-4.	Same as Alternative WG-4.
Implementability	**High**	**High**	**High**	**High**	**High**	**High**	**Moderate to High**
Technical Feasibility	No additional actions would be implemented. There are no implementability issues with this alternative.	No remedial construction or maintenance would be required and MNA would be easy to implement. Long-term monitoring of MNA would be technically feasible.	Implementation of ICs would be technically feasible.	Construction of Dinwoody or Salt Lake Formation/chert covers would be technically feasible. Simplot has installed the same cover at the Pole Canyon ODA. The target cover areas comprise 194 acres and therefore approximately 940,000 cubic yards of Dinwoody or Salt Lake Formation and 630,000 cubic yards of chert would be required for construction. Sufficient volumes of chert material are expected to be recovered from ongoing mining and multiple sources of Dinwoody or Salt Lake Formation material could be available, depending on active mining. Because of uncertainties with the volumes of material available from active mining, for the purposes of this report, it is assumed that the Sage Valley borrow area will provide Dinwoody or Salt Lake Formation material for the covers. Construction of Dinwoody or Salt Lake Formation/chert covers would not require specialized construction techniques or special access logistics. Implementation of ICs would be technically feasible. Inspections, O&M, and performance and effectiveness monitoring of covers would be implementable.	Construction of capillary covers would be technically feasible. Simplot has installed covers using similar materials at the Smoky Canyon Mine. The target cover areas comprise 194 acres and therefore approximately 630,000 cubic yards of Dinwoody or Salt Lake Formation and 310,000 cubic yards of chert would be required for construction (with additional Dinwoody or Salt Lake Formation material required to form the working base). Sufficient volumes of chert material are expected to be recovered from ongoing mining and multiple sources of Dinwoody or Salt Lake Formation material could be available, depending on active mining. Because of uncertainties with the volumes of material available from active mining, for the purposes of this report, it is assumed that the Sage Valley borrow area will provide Dinwoody or Salt Lake material for the covers. Construction of capillary covers would not require specialized construction techniques or special access logistics. Implementation of ICs would be technically feasible. Inspections, O&M, and performance and effectiveness monitoring of covers would be implementable.	Construction of Enhanced Dinwoody covers would be technically feasible. Simplot has enhanced Dinwoody covers at Panel F for reclamation of active mining. The target cover areas comprise 194 acres and therefore approximately 630,000 cubic yards of Dinwoody or Salt Lake Formation, 310,000 cubic yards of chert and 310,000 cubic yards of topsoil would be required for construction of the cover. Sufficient volumes of chert material are expected to be recovered from ongoing mining and multiple sources of Dinwoody or Salt Lake Formation material could be available, depending on active mining. Because of uncertainties with the volumes of material available from active mining, for the purposes of this report, it is assumed that the Sage Valley borrow area will provide Dinwoody or Salt Lake material for the covers. Construction of Enhanced Dinwoody covers would not require specialized construction techniques or special access logistics. Given the increased number of layers to be constructed with the Enhanced Dinwoody cover system (e.g., the 100% compact screened Dinwoody and bentonite amended layers) it will be difficult to construct more than 30 to 35 acres in a given construction season at Smoky Canyon Mine, with the limited construction season. This will lead to several years of construction to complete the 194 acres. Implementation of ICs would be technically feasible. Inspections, O&M, and performance and effectiveness monitoring of covers would be implementable.	Construction of geomembrane covers would be technically feasible. Geomembrane covers have been installed at South Maybe Canyon Mine (a CERCLA action on a cross-valley fill). Geomembrane covers can be constructed using specialized construction techniques. Inspections, O&M, and performance and effectiveness monitoring of covers would be implementable.
Administrative Feasibility	There are no administrative requirements.	Administrative requirements for development and implementation of a new long-term groundwater monitoring plan to evaluate the effectiveness of MNA would be implementable.	Administrative requirements include preparation of an ICIAP that specifies who is responsible for implementing and ensuring the stewardship of deed restrictions over the long term. The ICIAP would require approval by the Agencies and would be feasible to implement.	Administrative requirements for development of an O&M plan for the cover system would be implementable. Requirements for the ICIAP would also be administratively feasible.	Same as Alternative WG-4.	Same as Alternative WG-4.	Same as Alternative WG-4.

TABLE 2-2. Screening Evaluation of Remedial Alternatives for Wells Formation Groundwater

	Alternative WG-1 No Further Action	Alternative WG-2 Monitored Natural Attenuation (MNA)	Alternative WG-3 Institutional Controls (ICs)	Alternative WG-4 5-Foot Dinwoody or Salt Lake Formation/Chert Covers, ICs and MNA	Alternative WG-5 Capillary Covers, ICs and MNA	Alternative WG-6 Enhanced Dinwoody Covers, ICs and MNA	Alternative WG-7 Geomembrane Covers, ICs and MNA
Cost	**Low**	**Low**	**Low**	**Moderate**	**Moderate**	**High**	**High**
Undiscounted Capital Cost	$0	$0	$50,000	$20 Million	$33 Million	$60 Million	$74 Million
Screening Result	**RETAINED**	**RETAINED with Other Alternatives**	**RETAINED**	**NOT RETAINED**	**RETAINED**	**NOT RETAINED**	**RETAINED**
Comments	No further action is RETAINED as required by the NCP.	It appears that the geochemical attenuation mechanism does not currently limit the extent of selenium transport from source areas, and natural attenuation may offer only limited reductions in selenium concentrations in groundwater downgradient of those sources. However, conditions in waste rock within pit backfill and external ODAs are variable and may become less oxic over time, which could affect groundwater conditions. Therefore, natural attenuation may be effective and may result in a reduction of selenium concentrations over time. MNA is RETAINED in conjunction with other remedial alternatives (i.e., source control) for the detailed analysis.	ICs would provide immediate protection of human health by preventing use of Wells Formation groundwater with selenium concentrations above the MCL as a drinking water source on Simplot-owned land in Sage Valley. This alternative is RETAINED for the detailed analysis.	A 5-foot Dinwoody or Salt Lake Formation/chert cover would reduce infiltration of water into the ODA surface (and subsequent release of selenium to Wells Formation groundwater); however, it has a lower effectiveness than a capillary cover. This alternative is NOT RETAINED for the detailed analysis of alternatives.	A capillary cover is implementable and would reduce infiltration of water into the ODA surface (and subsequent release of selenium to Wells Formation groundwater) at a higher effectiveness than 5-foot Dinwoody or Salt Lake Formation/chert covers. This alternative is RETAINED for the detailed analysis of alternatives.	Enhanced Dinwoody covers have been shown to be effective at Panel F, where they are integrated with placement of overburden generated by active mining. The Enhanced Dinwoody cover performance is similar to geomembrane covers, which are retained for the detailed analysis. To avoid carrying forward too many similar options Enhanced Dinwoody covers are NOT RETAINED for the detailed analysis.	Geomembrane covers are effective in reducing infiltration into the ODA surface in the short term, but the geomembrane has a finite life expectancy because it is composed of man-made materials. This alternative is RETAINED for the detailed analysis to provide an analysis of the type of cover that has the potential to provide the highest reduction in infiltration into overburden materials.

Notes:

ARARs - Applicable or Relevant and Appropriate Requirements
CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act
GCLL - Geosynthetic Clay Laminate Liner
ICIAP - Institutional Control Implementation and Assurance Plan
ICs - Institutional Controls
MCL - Maximum Contaminant Level
MNA - Monitored Natural Attenuation
NCP - National Oil and Hazardous Substances Contingency Plan
NTCRA - Non-Time-Critical Removal Action
O&M - Operation and Maintenance
ODA - Overburden Disposal Area
QA/QC - Quality Assurance/Quality Control

TABLE 2-3. Screening Evaluation of Remedial Alternatives for Surface Water

	Alternative SW-1 No Further Action	Alternative SW-2 5-Foot Dinwoody or Salt Lake Formation/ Chert Covers	Alternative SW-3 Capillary Covers	Alternative SW-4 Enhanced Dinwoody Covers	Alternative SW-5 Geomembrane Covers	Alternative SW-6 Treatment of Water Discharging at Hoopes Spring
Components	No additional actions	5-Foot Dinwoody or Salt Lake Formation/chert covers Storm water run-on / runoff controls Rock covers on seeps and detention ponds Long-term surface water monitoring and O&M	Capillary covers with drainage benches Storm water run-on/runoff controls Rock covers on seeps and detention ponds Long-term surface water monitoring and O&M	Enhanced Dinwoody covers Storm water run-on / runoff controls Rock covers on seeps and detention ponds Long-term surface water monitoring and O&M	Geomembrane covers Storm water run-on / runoff controls Rock covers on seeps and detention ponds Long-term surface water monitoring and O&M	Continue water treatment at Hoopes WTP Rock covers on seeps and detention ponds Long-term performance monitoring and O&M
Effectiveness	**Low**	**Moderate to High**	**Moderate to High**	**Moderate to High**	**Moderate to High**	**High**
Protection of Human Health and the Environment	Human health would not be protected because people could ingest non-regulated surface water with arsenic concentrations above the MCL from seeps and detention ponds. Selenium concentrations in surface water downstream of Hoopes Spring and South Fork Sage Creek Springs are anticipated to decrease over time which would reduce environmental risks.	Human health would be protected through the use of fences and/or signs in the short term and ultimately rock covers to prevent ingestion of surface water in seeps and detention ponds with arsenic concentrations greater than the MCL. Concentrations of selenium in surface water in Sage Creek and Crow Creek downstream of Hoopes Spring are anticipated to decease over time which would reduce environmental risks.	Same as Alternative SW-2.	Same as Alternative SW-2.	Same as Alternative SW-2.	Same as Alternative SW-2. Environmental risks would be reduced because selenium concentrations in surface water in the Sage/Crow Creek watershed downstream of Hoopes Spring would be immediately reduced by treatment.
Compliance With ARARs	No additional actions would be implemented. Selenium concentrations in surface water downgradient of Hoopes Spring and South Fork Sage Creek Springs are anticipated to decrease over time. However, it is uncertain whether they will reduce below the surface water quality standards at all monitoring locations in Sage Creek and Crow Creek over the long term.	Surface water quality standards are not currently met in surface water in Sage Creek and Crow Creek downstream of Hoopes Spring. Selenium concentrations are anticipated to decrease over time; however, it is uncertain whether they will ultimately reduce below the water quality standard at all monitoring locations in Sage Creek and Crow Creek over the long term.	Same as Alternative SW-2.	Same as Alternative SW-2.	Same as Alternative SW-2.	Treatment would immediately reduce selenium concentrations in Sage Creek/Crow Creek and improve the likelihood of meeting the surface water quality standards in Sage Creek and Crow Creek.
Long Term Effectiveness and Permanence	No additional actions would be implemented. Mass flux of selenium to surface water from discharge of Wells Formation groundwater is also anticipated to decrease over time, which would cause a proportional reduction of selenium concentrations in downstream surface water. It is uncertain whether selenium concentrations will reduce below the surface water quality standards over the long term. Human health would not be protected because people could still be exposed to arsenic in seeps and ponds.	Installing a 5-foot Dinwoody or Salt Lake Formation/chert cover is estimated to reduce the infiltration of water for an average precipitation year by 29%. This would lead to a similar reduction of selenium releases at the target cover areas and would be expected to reduce selenium mass flux in Wells Formation groundwater and consequently the mass flux discharging at the springs complex over time. Rock covers would be effective in preventing the ingestion of surface water in seeps and detention ponds with arsenic concentrations greater than the MCL. Long-term surface water monitoring and O&M would be required to monitor the performance and effectiveness of the covers.	Installing a capillary cover is estimated to reduce the infiltration of water for an average precipitation year by 58%. This would lead to similar reduction of selenium releases at the target areas and would be expected to reduce selenium mass flux in Wells Formation groundwater and consequently the mass flux discharging at the springs complex over time. Rock covers would be effective in preventing the ingestion of surface water in seeps and detention ponds with arsenic concentrations greater than the MCL. Long-term surface water monitoring and O&M would be required to monitor the performance and effectiveness of the covers.	Installing an Enhanced Dinwoody cover is estimated to reduce the infiltration of water for an average precipitation year by 95%. This would lead to similar reduction of selenium releases at the target cover areas and would be expected to reduce selenium mass flux in Wells Formation groundwater and consequently the mass flux discharging at the springs complex over time. Rock covers would be effective in preventing the ingestion of surface water in seeps and detention ponds with arsenic concentrations greater than the MCL. Long-term surface water monitoring and O&M would be required to monitor the performance and effectiveness of the covers.	Installing a geomembrane cover is predicted to reduce the infiltration of water for an average precipitation year by 100% in the short term. This would lead to similar reduction of selenium releases at the target cover areas and would be expected to reduce selenium mass flux in Wells Formation groundwater and consequently the mass flux discharging at the springs complex over time. However, the geomembrane materials have a finite life expectancy because they are composed of man-made materials. Rock covers would be effective in preventing the ingestion of surface water in seeps and detention ponds with arsenic concentrations greater than the MCL. Long-term surface water monitoring and O&M would be required to monitor the performance and effectiveness of the covers.	Selenium concentrations in surface water in the Sage/Crow Creek watershed downstream from Hoopes Spring and South Fork Sage Creek Springs would be immediately reduced by treatment. The pilot treatment system has removed approximately 40% of the total selenium mass flux emanating from Hoopes Spring and the Springs at South Fork Sage Creek with a corresponding reduction in concentrations in the downstream portions of Sage Creek and Crow Creek. If the treatment system were increased in total capacity from 2,000 to 3,000 gpm, the reduction in mass flux would be on the order of 60%. Mass flux of selenium to surface water from discharge of Wells Formation groundwater is anticipated to decrease over time. This would cause a proportional reduction of selenium concentrations in downstream surface water in the future. Rock covers would be effective in preventing the ingestion of surface water in seeps and detention ponds with arsenic concentrations greater than the MCL. Long-term surface water monitoring and O&M would be required to evaluate the effectiveness of the treatment system.
Reduction of Toxicity, Mobility, or Volume Through Treatment	The water treatment pilot at Hoopes Springs would be terminated and the treatment system removed. No additional treatment would be implemented.	Same as Alternative SW-1.	Same as Alternative SW-1.	Same as Alternative SW-1.	Same as Alternative SW-1.	The toxicity, mobility and volume of selenium in surface water would be reduced through treatment at the Hoopes WTP.

TABLE 2-3. Screening Evaluation of Remedial Alternatives for Surface Water

	Alternative SW-1 No Further Action	Alternative SW-2 5-Foot Dinwoody or Salt Lake Formation/ Chert Covers	Alternative SW-3 Capillary Covers	Alternative SW-4 Enhanced Dinwoody Covers	Alternative SW-5 Geomembrane Covers	Alternative SW-6 Treatment of Water Discharging at Hoopes Spring
Short-Term Effectiveness	No additional actions would be implemented.	Risk of construction worker exposure to overburden material during remedial construction activities would be mitigated using standard health and safety protocols. Remedial construction workers would wear appropriate PPE.	Same as Alternative SW-2.	Same as Alternative SW-2.	Same as Alternative SW-2.	There would be no short-term impacts to human health or the environment related to construction of a remedy for continued use of the existing Hoopes WTP. Risks to construction workers while building an additional treatment train at the Hoopes WTP would be mitigated with standard health and safety protocols. Remedial construction workers would wear appropriate PPE.
Implementability	**High**	**High**	**High**	**High**	**Moderate to High**	**High**
Technical Feasibility	No additional actions would be implemented. There are no implementability issues with this alternative.	Construction of Dinwoody or Salt Lake Formation/chert covers would be technically feasible. Simplot has installed a similar cover at the Pole Canyon ODA. Sufficient volumes of chert material are expected to be recovered from ongoing mining and multiple sources of Dinwoody or Salt Lake Formation material could be available, depending on active mining. Because of uncertainties with the volumes of material available from active mining, for the purposes of this report, it is assumed that the Sage Valley borrow area will provide Dinwoody or Salt Lake material for the covers. Construction of Dinwoody or Salt Lake Formation/chert covers would not require specialized construction techniques or special access logistics. Placement of rock covers as a physical barrier layer on seeps and detention ponds to prevent direct contact with surface water with arsenic concentrations greater than the MCL would be easy to implement using readily available Site materials. Inspections, O&M, and performance and effectiveness monitoring of the covers would be implementable.	Construction of capillary covers would be technically feasible. Simplot has installed covers using similar materials at the Smoky Canyon Mine. Sufficient volumes of chert material are expected to be recovered from ongoing mining and multiple sources of Dinwoody or Salt Lake Formation material could be available, depending on active mining. Because of uncertainties with the volumes of material from active mining, for the purposes of this report, it is assumed that the Sage Valley borrow area will provide Dinwoody or Salt Lake Formation material for the covers. Construction of capillary covers would not require specialized construction techniques or special access logistics. Placement of rock covers as a physical barrier layer on seeps and detention ponds to prevent direct contact with surface water with arsenic concentrations greater than the MCL would be easy to implement using readily available Site materials. Inspections, O&M, and performance and effectiveness monitoring of the covers would be implementable.	Construction of Enhanced Dinwoody covers would be technically feasible and would not require specialized construction techniques or special access logistics. Simplot has installed Enhanced Dinwoody covers at Panel F for reclamation of active mining. Given the increased number of layers to be constructed with the Enhanced Dinwoody cover system (e.g., the 100% compact screened Dinwoody and bentonite amended layers) it will be difficult to construct more than 30 to 35 acres in a given construction season at Smoky Canyon Mine, with the limited construction season. This will lead to several years of construction to complete the 194 acres. Placement of rock covers as a physical barrier layer on seeps and detention ponds to prevent direct contact with surface water with arsenic concentrations greater than the MCL would be easy to implement using readily available Site materials. Inspections, O&M, and performance and effectiveness monitoring of the covers would be implementable.	Construction of geomembrane covers would be technically feasible. Geomembrane covers have been installed at South Maybe Canyon Mine (a CERCLA action on a cross-valley fill). Geomembrane covers can be constructed using specialized construction techniques but can have constructability issues and long-term sustainability concerns. Placement of rock covers as a physical barrier layer on seeps and detention ponds to prevent direct contact with surface water with arsenic concentrations greater than the MCL would be easy to implement using readily available Site materials. Inspections, O&M, and performance and effectiveness monitoring of the covers would be implementable.	Continued use of the Hoopes WTP, which consists of two FBR units with accompanying UF/RO systems, and possibly addition of a third FBR unit would be technically feasible. The FBRs generate a sludge that require management and disposal. Construction of rock covers on seeps and detention ponds would be implementable. Long-term performance monitoring and O&M of the water treatment system would be implementable.
Administrative Feasibility	There are no administrative requirements for this alternative.	Administrative requirements for development and implementation of an O&M plan for the covers would be implementable.	Same as Alternative SW-2.	Same as Alternative SW-2.	Same as Alternative SW-2.	The administrative feasibility of constructing, operating and maintaining another FBR treatment train at the Hoopes WTP would be straightforward and has previously been performed as part of the Pilot Study (i.e., adding the second treatment train). Administrative requirements associated with O&M and performance and effectiveness monitoring and reporting for the Hoopes WTP would be implementable.
Cost	**Low**	**Moderate**	**Moderate**	**High**	**High**	**Moderate**
Undiscounted Capital Cost	$0	$20 Million	$33 Million	$60 Million	$74 Million	$38 Million
Screening Result	**RETAINED**	**NOT RETAINED**	**RETAINED**	**NOT RETAINED**	**RETAINED**	**RETAINED**
Comments	No further action is RETAINED as required by the NCP.	A 5-foot Dinwoody or Salt Lake Formation/chert cover would reduce infiltration of water into the ODA surface (and subsequent release of selenium to Wells Formation groundwater), however, it has a lower effectiveness than a capillary cover. This alternative is NOT RETAINED for the detailed analysis of alternatives.	A capillary cover is implementable and would reduce infiltration of water into the ODA surface (and subsequent release of selenium to Wells Formation groundwater and migration to surface water via discharge at the springs complex) at a higher effectiveness than 5-foot Dinwoody or Salt Lake Formation/chert covers. This alternative is RETAINED for the detailed analysis of alternatives.	Enhanced Dinwoody covers have been shown to be effective at Panel F, where they are integrated with placement of overburden generated by active mining. The Enhanced Dinwoody cover performance is similar to geomembrane covers, which are retained for the detailed analysis. To avoid carrying forward too many similar options, the Enhanced Dinwoody covers are NOT RETAINED for the detailed analysis.	Geomembrane covers are effective in reducing infiltration into the ODA surface in the short term, but the geomembrane has a finite life expectancy because it is composed of man-made materials. This alternative is RETAINED for the detailed analysis to provide an analysis of the type of cover that has the potential to provide the highest reduction in infiltration into overburden materials.	Water treatment has an immediate effect on selenium concentrations in the Sage Creek/Crow Creek watershed and is RETAINED for the detailed analysis.

Notes:

ARARs - Applicable or Relevant and Appropriate Requirements
CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act
FBR - Fluidized Bed Bioreactor
gpm - gallons per minute
ICs - Institutional Controls
mg/L - milligrams per liter
MCL - Maximum Contaminant Level
NCP - National Oil and Hazardous Substances Contingency Plan
NTCRA - Non-Time-Critical Removal Action
O&M - Operation and Maintenance
ODA - Overburden Disposal Area
QA/QC - Quality Assurance/Quality Control
WTP - Water Treatment Plant

TABLE 2-4. Screening Evaluation of Remedial Alternatives for Alluvial Groundwater

	Alternative AG-1 **No Further Action**	**Alternative AG-2** **Monitored Natural Attenuation (MNA)**	**Alternative AG-3** **Institutional Controls (ICs) and MNA**	**Alternative AG-4** **Permeable Reactive Barrier (PRB), ICs and MNA**
Components	No additional actions	MNA of alluvial groundwater Long-term groundwater monitoring	ICs (deed restrictions) MNA of alluvial groundwater Long-term groundwater monitoring	PRB to treat alluvial groundwater at LP-1 ICs (deed restrictions) MNA of alluvial groundwater O&M and long-term monitoring of PRB
Effectiveness	**Low**	**Low**	**Moderate to High**	**High**
Protection of Human Health and the Environment	Human health would not be protected because groundwater with selenium concentrations above the MCL could be used as a source of drinking water in the future. There are no environmental risks associated with alluvial groundwater.	Same as Alternative AG-1.	Human health would be protected because ICs (deed restrictions) would prevent use of alluvial groundwater with selenium concentrations above the MCL as a source of drinking water. There are no environmental risks associated with alluvial groundwater.	Same as Alternative AG-3.
Compliance With ARARs	No additional actions would be implemented. Mass transport of selenium in groundwater is anticipated to decrease over time as a result of effect of the Pole Canyon NTCRAs. This would result in a reduction in selenium concentrations. However, it is uncertain whether selenium concentrations will ultimately reduce to below MCLs at all monitoring locations over the long term.	The same reduction of selenium concentrations would occur over time as Alternative AG-1. The mass balance model indicates some attenuation of selenium; however, the attenuation in alluvial groundwater may be occurring farther downgradient in the organic-rich alluvial deposits along North Fork Sage Creek in Sage Valley where the groundwater is very near the surface.	The same reduction of selenium concentrations would occur over time as Alternative AG-1. Although some attenuation is occurring in the organic-rich alluvial deposits in Sage Valley, Site data indicate that limited natural attenuation of selenium is occurring in the alluvial groundwater.	The PRB would have an immediate effect on reducing selenium concentrations in downgradient alluvial groundwater.
Long Term Effectiveness and Permanence	No additional actions would be implemented. Mass transport of selenium in groundwater is anticipated to decrease over time. Human health would not be protected because groundwater with selenium concentrations above the MCL could still be used as a source of drinking water in the future.	The effectiveness of MNA depends on source-control remedies and aquifer conditions (i.e., anoxic or low-oxygen conditions). Although some attenuation may be occurring in the organic-rich alluvial deposits in Sage Valley, Site data indicate that limited natural attenuation of selenium is occurring in the alluvial groundwater. Human health would not be protected because groundwater with selenium concentrations above the MCL could still be used as a source of drinking water in the future. Long-term monitoring would be required to assess the progress of the natural attenuation in alluvial groundwater.	ICs (deed restrictions) would be effective in preventing the use of alluvial groundwater with selenium concentrations above the MCL as a source of drinking water. Deed restrictions would only be applied to areas where selenium concentrations exceed the MCL and would be ultimately be removed when the MCL is met throughout Simplot-owned land in Sage Valley. Long-term monitoring would be required to assess the progress of the natural attenuation in alluvial groundwater.	ICs (deed restrictions) would prevent the use of alluvial groundwater with selenium concentrations above the MCL as a source of drinking water. Deed restrictions would only be applied to areas where selenium concentrations exceed the MCL and would be ultimately be removed when the MCL is met throughout Simplot-owned land in Sage Valley. The PRB technology is an in-situ permeable system that uses reactive media designed to passively treat intercepted contaminated groundwater. Chemical reactions between the reactive media and contaminated groundwater flowing through the media results in transformation or immobilization of the contaminants. Mass transport of selenium in alluvial groundwater is anticipated to decrease over time as the effect of releases during active mining diminishes and because of the effect of subsequent reclamation/NTCRA actions. This would result in a reduction in selenium concentrations. O&M and long-term groundwater monitoring would be required to evaluate the effectiveness of the PRB over time and to assess the progress of natural attenuation in alluvial groundwater.
Reduction of Toxicity, Mobility, or Volume Through Treatment	No treatment would be implemented.	Significant selenium attenuation has not been observed.	Same as Alternative AG-2.	The toxicity, mobility, and volume of selenium contaminated alluvial groundwater would be reduced by the reactive media in the PRB.
Short-Term Effectiveness	No additional actions would be implemented.	Same as Alternative AG-1.	Same as Alternative AG-1.	Risks to construction workers during remedial construction activities would be mitigated using standard health and safety protocols. Remedial construction workers would wear appropriate PPE.

TABLE 2-4. Screening Evaluation of Remedial Alternatives for Alluvial Groundwater

	Alternative AG-1 No Further Action	Alternative AG-2 Monitored Natural Attenuation (MNA)	Alternative AG-3 Institutional Controls (ICs) and MNA	Alternative AG-4 Permeable Reactive Barrier (PRB), ICs and MNA
Implementability	**High**	**High**	**High**	**High**
Technical Feasibility	No additional actions would be implemented. There are no implementability issues with this alternative.	No remedial construction or maintenance would be required and MNA would be easy to implement. Long-term monitoring of MNA would be technically feasible.	Implementation of ICs would be technically feasible.	Installation, O&M, and long-term monitoring of the PRB would be technically feasible. The PRB would be constructed of appropriate reactive media, would have a hydraulic conductivity similar to nearby alluvium/bedrock, and seep inflow would have a retention time adequate to treat selenium. A similar PRB has been constructed at the Conda Mine.
Administrative Feasibility	There are no administrative requirements for this alternative.	Administrative requirements for development and implementation of a new long-term monitoring plan to evaluate the effectiveness of MNA would be implementable.	Administrative requirements would include preparation of an ICIAP that specifies who is responsible for implementing and ensuring the stewardship of the deed restrictions over the long term. The ICIAP would require approval by the Agencies and would be feasible to implement. Development and implementation of a new long-term monitoring plan to evaluate the effectiveness of MNA would also be implementable.	Administrative requirements would include Agency approval of the PRB design documents. Design and implementation of the PRB and implementation of ICs would be administratively feasible. Development and implementation of a new long-term monitoring plan to evaluate the effectiveness of MNA would also be implementable.
Cost	**Low**	**Low**	**Low**	**High**
Undiscounted Capital Cost	$0	$0	$50,000	$444,100
Screening Result	**RETAINED**	**RETAINED**	**RETAINED**	**RETAINED**
Comments	No further action is RETAINED as required by the NCP.	It appears that the geochemical attenuation mechanism does not currently limit the extent of selenium transport from the Pole Canyon ODA, and natural attenuation may offer only limited reductions in selenium concentrations in downgradient alluvial groundwater. However, conditions in waste rock within ODAs are variable and may become less oxic over time, which could affect conditions in groundwater. Therefore, natural attenuation may be effective and may result in a reduction of selenium concentrations over time. MNA is RETAINED in conjunction with other remedial alternatives (i.e., source control) for the detailed analysis.	This alternative would provide immediate protection of human health and is RETAINED for the detailed analysis.	A PRB would immediately reduce selenium concentrations in downgradient alluvial groundwater. This alternative is RETAINED for the detailed analysis.

Notes:

ARARs - Applicable or Relevant and Appropriate Requirements
ICIAP - Institutional Control Implementation and Assurance Plan
ICs - Institutional Controls
MCL - Maximum Contaminant Level
MNA - Monitored Natural Attenuation
NCP - National Oil and Hazardous Substances Contingency Plan
NTCRA - Non-Time-Critical Removal Action
O&M - Operation and Maintenance
ODA - Overburden Disposal Area
PPE - Personal Protective Equipment
PRB - Permeable Reactive Barrier

TABLE 2-5. Screening Evaluation of Remedial Alternatives for Solids and Soil

	Alternative S-1 **No Further Action**	**Alternative S-2** **Rock Covers on Soils in Seep and Riparian Areas**	**Alternative S-3** **2-Foot Dinwoody or Salt Lake Formation Covers on Uncovered Areas of ODAs and Rock Covers on Soils in Seep and Riparian Areas**	**Alternative S-4** **5-Foot Dinwoody or Salt Lake Formation/Chert Covers on Uncovered Areas of ODAs and Rock Covers on Soils in Seep and Riparian Areas**
Components	No additional actions	Rock covers on soils in seep and riparian areas and detention ponds below ODAs	2-Foot Dinwoody or Salt Lake Formation covers on uncovered areas of ODAs Stormwater run-on / runoff controls Rock covers on soils in seep and riparian areas and detention ponds below ODAs ICs (grazing controls, land-use controls, information programs) Inspections and O&M	5-Foot Dinwoody or Salt Lake Formation/chert covers on uncovered areas of ODAs Stormwater run-on / runoff controls Rock covers on soils in seep and riparian areas and detention ponds below ODAs ICs (grazing controls, land-use controls, information programs) Inspections and O&M
Effectiveness	**Moderate**	**Moderate to High**	**High**	**High**
Protection of Human Health and the Environment	The Site has approximately 1,060 acres of covered overburden wither by post-reclamation (Panels C and E, areas of Panels A and D, and the areas at Panel B where mining has been completed) or by NTCRA (Pole Canyon ODA). No additional response actions would be implemented to cover additional ODA areas and residual risks would not change.	The Site has approximately 1,060 acres of covered overburden, either by post-mining reclamation (Panels C and E, areas of Panels A and D, and areas at Panel B where mining has been completed) or by NTCRA (Pole Canyon ODA). No additional response actions would be implemented to cover additional ODA areas and residual risks related to ODAs would not change. Rock covers would eliminate exposure to selenium in soil in seep and riparian areas and detention ponds below ODAs and would reduce ecological risks.	The Site has approximately 1,060 acres of covered overburden, either by post-mining reclamation (Panels C and E, areas of Panels A and D, and areas at Panel B where mining has been completed) or by NTCRA (Pole Canyon ODA). Covering all uncovered areas at Panel A and Panel D (360 acres) would eliminate all areas of exposed overburden at the Site. Rock covers would cover soils in seep and riparian areas and detention ponds below ODAs where terrestrial biota could be exposed to selenium in soil.	Same as Alternative S-3.
Compliance With ARARs	There are no chemical-specific ARARs for selenium in soil.	Same as Alternative S-1.	Same as Alternative S-1.	Same as Alternative S-1.
Long Term Effectiveness and Permanence	No additional response actions would be implemented so residual risks would not change.	Residual risks related to ODAs would not change. Rock covers would be effective in preventing contact with or ingestion of arsenic and selenium in soil by terrestrial biota over the long term.	The covers at Panels A and D would be effective as physical barriers to prevent direct contact with overburden material. Long-term effectiveness would rely on O&M to limit erosion of cover soil.	Same as Alternative S-3.
Reduction of Toxicity, Mobility, or Volume Through Treatment	No treatment would be implemented.	Same as Alternative S-1.	Same as Alternative S-1.	Same as Alternative S-1.
Short-Term Effectiveness	No additional actions would be implemented.	Risks to construction workers during remedial construction activities would be mitigated using standard health and safety protocols. Remedial construction workers would wear appropriate PPE.	Same as Alternative S-2.	Same as Alternative S-2.
Implementability	**High**	**High**	**High**	**High**
Technical Feasibility	No additional actions would be implemented. There are no implementability issues with this alternative.	Construction of rock covers on soils in seep and riparian areas and detention ponds below ODAs would be easy to implement.	Construction of covers at Panels A and D would be technically feasible. Dinwoody Formation material has been used to construct covers throughout the Site. A 2-foot-thick cover over 360 acres would require approximately 1.1 million cubic yards of material. Active mining at Panels F and G could generate excess Dinwoody material that could be used for CERCLA covers. Another potential option is to source Dinwoody or Salt Lake Formation material from Simplot's private land in Sage Valley. The construction of Dinwoody or Salt Lake Formation covers would not require specialized construction techniques or special access logistics. Construction of rock covers on soils in seep and riparian areas and detention ponds below ODAs would be easily implementable. Implementation of ICs to restrict access to cover areas while the cover vegetation matures would be technically feasible. Inspections and O&M of the covers at Panels A and D would be technically feasible.	Construction of covers and associated stormwater controls at Panels A and D would be technically feasible. The same cover has been installed at the Pole Canyon ODA. To construct the cover over 360 acres would require approximately 1.7 million cubic yards of Dinwoody or Salt Lake Formation and 1.1 million cubic yards of chert. Sufficient volumes of chert material are expected to be recovered from ongoing mining. Sufficient Dinwoody or Salt Lake Formation is available from Simplot's land in Sage Valley. The construction of Dinwoody or Salt Lake Formation/chert covers would not require specialized construction techniques or special access logistics. Construction of rock covers on soils in seep and riparian areas and detention ponds below ODAs would be easily implementable. Implementation of ICs to restrict access to cover areas while the cover vegetation matures would be technically feasible. Inspections and O&M of the covers at Panels A and D would be technically feasible.
Administrative Feasibility	There are no administrative requirements for this alternative.	Same as Alternative S-1.	Administrative requirements for development of a new O&M plan for the covers would be implementable.	Same as Alternative S-3.
Cost	**Low**	**Low**	**Moderate**	**High**
Undiscounted Capital Cost	$0	$22,400	$18 Million	$33 Million
Screening Result	**RETAINED**	**RETAINED**	**RETAINED**	**NOT RETAINED**
Comments	No further action is RETAINED as required by the NCP.	Alternative S-2 would prevent access to soil in seep and riparian areas and detention ponds below ODAs and is RETAINED for the detailed analysis of alternatives.	Alternative S-3 would eliminate all areas of uncovered overburden at the Site and is RETAINED for the detailed analysis.	Alternative S-4 would provide the same level of effectiveness as Alternative S-3. The thicker cover would not provide additional protection. It has a significantly higher cost and is therefore NOT RETAINED.

Notes:
ARARs - Applicable or Relevant and Appropriate Requirements
ICs - Institutional Controls
NCP - National Oil and Hazardous Substances Pollution Contingency Plan
NTCRA - Non-Time-Critical Removal Action
ODA - Overburden Disposal Area
O&M - Operations and Maintenance
PPE - Personal Protective Equipment
RAOs - Remedial Action Objectives

TABLE 2-6. Concentrations of Total Selenium, Sulfate, Dissolved Iron, Dissolved Manganese, and Dissolved Oxygen in Select Wells, Springs, and Seeps

Location	Sample Date	Selenium, Total (mg/L)	Selenium, Dissolved (mg/L)	Sulfate (mg/L)	Manganese, Dissolved (mg/L)	Iron, Dissolved (mg/L)	Dissolved Oxygen (mg/L)	ORP (mV)
Wells Formation Groundwater								
GW-16	10/29/2003	0.447	0.464	157	0.0416	0.0045	10.19	144.8
GW-16	2/3/2004	0.536	0.53	188	0.0119	0.013	4.78	96.8
GW-16	5/9/2004	0.539	0.43	215	0.0089	0.0124	7.35	89.6
GW-16	7/24/2004						8.89	225.6
GW-16	7/25/2004	0.64	0.54	235	0.0027	0.0124		
GW-16	11/8/2004	0.552	0.681	229	0.0006	0.011	7.5	
GW-16	5/26/2005	0.712	0.722	230				
GW-16	5/19/2006	0.822	0.7	261				
GW-16	9/20/2006	0.723	0.714	251			10.7	
GW-16	10/18/2006	0.492	0.476	254			10.97	-122
GW-16	6/12/2007	0.887		261				
GW-16	11/28/2007	0.806	0.799	236	0.0007			
GW-16	7/1/2008	0.905	0.91	264	0.0013		7.74	
GW-16	9/10/2008	1.27	1.02	251	0.0013		7.86	
GW-16	3/27/2009	0.79	0.825	222			10.98	
GW-16	6/2/2009	0.849	0.86	233	0.0013		2.85	
GW-16	7/30/2009	0.847	0.849	249			3.59	
GW-16	10/25/2009	0.778	0.757	233			11.37	43.9
GW-16	11/21/2009	0.759	0.764	237	0.0019		10.9	156.5
GW-16	3/25/2010	0.871	0.803	229	0.0019		12.18	394.6
GW-16	6/8/2010	0.834	0.787	226	0.00283	0.018	8.74	16.4
GW-16	9/10/2010	0.844	0.793	232			11.85	163.7
GW-16	11/11/2010	0.765	0.757	222	0.00024	0.027	12.24	177.2
GW-16	6/2/2011	0.858	0.838	260			12.68	53.4
GW-16	6/15/2011	0.761	0.686	236	0.0017		11.87	106
GW-16	7/19/2011	0.792	0.803	224				
GW-16	7/20/2011						11.07	181.6
GW-16	9/27/2011	0.798	0.801	227			12.05	402.1
GW-16	11/7/2011	0.769	0.764	237	0.00055		11.26	169.6
GW-16	4/25/2012	0.803	0.801	223			10.86	49.9
GW-16	5/11/2012	0.784	0.788	226	0.000071		11.49	79
GW-16	7/23/2012	0.81	0.812	234			11.6	196.5
GW-16	8/30/2012	0.855	0.856	240			12.4	78.1
GW-16	9/13/2012	0.785	0.766	231			12.49	69.3
GW-16	11/15/2012	0.752	0.748	231	0.0004		16.14	-70.7
GW-16	5/21/2013	0.807	0.805	228	0.0004		9.7	119.3
GW-16	9/18/2013	0.862	0.848	228			7.86	50.1
GW-16	11/15/2013	0.787	0.789	229	0.000036		8.13	47.8
GW-16	6/11/2014	0.918	0.913	245	0.00029		9.01	80.7
GW-16	8/26/2014	0.873	0.85	240			9.21	78.3
GW-16	11/19/2014	0.856	0.935	237	0.000019	0.023	9.57	66.6
GW-16	5/11/2015	0.922	0.926	237	0.00015	0.026	8.91	79.6
GW-16	7/28/2015	0.867	0.917	238	0.00042	0.048	9.82	148.5
GW-16	9/22/2015	0.865	0.889	230	0.00057	0.048	8.33	81.2
GW-16	11/11/2015	0.864	0.878	201	0.00013	0.048	9.34	62
GW-16	5/16/2016	0.901	0.924	219	0.00022	0.048	9.39	96
GW-16	7/14/2016	0.839	0.802	236	0.00029	0.039	9.63	157.3
GW-16	11/14/2016	0.786	0.766	216	0.00017	0.039	9.45	76.4
GW-16	6/6/2017	0.71	0.706	218	0.000135		8.99	123
GW-16	11/28/2017	0.648	0.668	201	0.00008		9.29	90.8
GW-16	5/15/2018	0.646	0.566	206	0.000467		9.63	111.1
GW-16	10/29/2018	0.543	0.547	186	0.00011		9.79	141.3

TABLE 2-6. Concentrations of Total Selenium, Sulfate, Dissolved Iron, Dissolved Manganese, and Dissolved Oxygen in Select Wells, Springs, and Seeps

Location	Sample Date	Selenium, Total (mg/L)	Selenium, Dissolved (mg/L)	Sulfate (mg/L)	Manganese, Dissolved (mg/L)	Iron, Dissolved (mg/L)	Dissolved Oxygen (mg/L)	ORP (mV)
GW-25	11/8/2007	0.00041	0.00042	3.89				
GW-25	10/1/2008	0.00036	0.00039	3.95	0.0038		11.56	
GW-25	11/18/2008	0.00035	0.00026	3.44			10.82	
GW-25	3/30/2009	0.00028	0.00029	3.63				
GW-25	6/2/2009	0.0036	0.0037	3.3			8.35	197.6
GW-25	10/3/2009	0.0028	0.0029	3.78			11.17	147.3
GW-25	11/22/2009	0.0026	0.0026	3.7			8.13	126.4
GW-25	6/6/2010	0.0024	0.0022	3.39	0.000458	0.018	8.28	-51.3
GW-25	7/10/2010		0.0018	5.95	0.00099		8.41	-6.8
GW-25	9/29/2010	0.0024	0.0023	3.5			8.14	-120.7
GW-25	11/14/2010	0.003	0.0031	3.6	0.00013	0.027	8.57	164.1
GW-25	6/18/2011	0.594	0.574	40			8.87	128.4
GW-25	8/3/2011	0.502	0.487	36.2			10.61	90.7
GW-25	11/8/2011	0.385	0.379	29.2			9.5	107.1
GW-25	12/20/2011	0.351	0.352	27.1				
GW-25	3/22/2012	0.296	0.291	24.6	0.0011		11.64	56.4
GW-25	4/24/2012						11.22	63.9
GW-25	4/25/2012	0.516	0.517	38				
GW-25	5/8/2012	0.511	0.512	36.3			11.74	30.2
GW-25	6/21/2012	0.439	0.433	31.3			11.88	14.6
GW-25	7/22/2012	0.422	0.403	29.1			11.83	150.2
GW-25	8/30/2012	0.344	0.347	27.7			11.93	85.8
GW-25	9/19/2012	0.344	0.341	25.3			17.4	24
GW-25	11/28/2012	0.317	0.324	23.7			11.86	-12.51
GW-25	5/21/2013	0.345	0.331	22.8			9.8	156.2
GW-25	9/17/2013	0.3	0.296	23.4			7.94	49.3
GW-25	11/12/2013	0.317	0.311	23.6			10.9	72
GW-25	6/24/2014	0.507	0.504	33.5			9.18	84
GW-25	8/27/2014	0.405	0.427	31			8.93	70.2
GW-25	11/6/2014	0.409	0.42	29.2			9	65.4
GW-25	4/16/2015	0.423	0.412	31			8.56	72.5
GW-25	5/27/2015	0.321	0.33	30.5			8.88	73.9
GW-25	9/10/2015	0.351	0.331	27.3			7.92	79.1
GW-25	11/18/2015	0.41	0.364	28.7			8.97	-47.9
GW-25	2/18/2016	0.418	0.443	32.1			8.47	101.9
GW-25	3/16/2016	0.432	0.435	32.7			8.44	60.7
GW-25	4/18/2016	0.416	0.418	32.8			8.36	60.4
GW-25	5/25/2016	0.372	0.381	29.4			8.72	87
GW-25	7/28/2016	0.373	0.385	28.9				
GW-25	10/26/2016	0.373	0.378	29.7			8.6	52.9
GW-25	3/20/2017	0.415	0.391	32.4			8.17	110.1
GW-25	5/3/2017	0.488	0.479	39.2			8.86	114.9
GW-25	8/17/2017	0.433	0.421	34.4			8.62	71.1
GW-25	11/13/2017	0.39	0.473	30.9			8.28	55.4
GW-25	3/29/2018	0.273	0.265	26.7			8.13	64.4
GW-25	5/8/2018	0.336	0.338	30.7			8.1	71.1
GW-25	7/9/2018						8.65	136.1
GW-25	7/10/2018	0.392	0.386	32.2				
GW-25	3/27/2019	0.277	0.319	26.2			7.63	137.8

TABLE 2-6. Concentrations of Total Selenium, Sulfate, Dissolved Iron, Dissolved Manganese, and Dissolved Oxygen in Select Wells, Springs, and Seeps

Location	Sample Date	Selenium, Total (mg/L)	Selenium, Dissolved (mg/L)	Sulfate (mg/L)	Manganese, Dissolved (mg/L)	Iron, Dissolved (mg/L)	Dissolved Oxygen (mg/L)	ORP (mV)
Springs and Seeps								
HS	6/4/1979	0.01		49	0.01	0.01		
HS	10/2/1979	0.001		41			4.7	
HS	9/15/1982	0.02		8.6				
HS	5/15/1984	0.002		38.7				
HS	9/15/1984	0.005		41				
HS	5/15/1985	0.003		43				
HS	9/15/1985	0.002		18				
HS	5/15/1986	0.003		43				
HS	9/15/1986	0.002		37				
HS	5/15/1987	0.002		33				
HS	9/15/1987	0.001		41				
HS	5/15/1988			41				
HS	9/15/1988			33				
HS	5/15/1989			43				
HS	9/15/1989			39				
HS	5/15/1990			45				
HS	9/15/1990			37				
HS	5/15/1991	0.002		41				
HS	9/15/1991	0.001		37				
HS	5/15/1992	0.003		62				
HS	9/15/1992	0.002		41				
HS	5/15/1993	0.003		54				
HS	9/15/1993	0.002		41				
HS	5/15/1994	0.002		42				
HS	9/15/1994	0.003		27				
HS	5/15/1995	0.001		40				
HS	9/15/1995	0.003		38				
HS	5/15/1996	0.003		40				
HS	9/15/1996	0.003		40				
HS	5/15/1997	0.003		40				
HS	9/15/1997	0.004		40				
HS	5/15/1998	0.004		60				
HS	9/15/1998	0.005		40				
HS	5/15/1999	0.007		50				
HS	9/15/1999	0.008		40				
HS	5/15/2000	0.01		40				
HS	6/21/2000						3.8	237
HS	6/22/2000	0.012	0.009	47	0.02	0.05		
HS	9/15/2000	0.01		50				
HS	9/26/2000	0.003	0.006	50	0.02	0.05	11.5	297
HS	5/15/2001	0.01		50				
HS	9/15/2001	0.012		50				
HS	5/16/2002	0.011	0.013	50			4.55	
HS	10/17/2002	0.013	0.009	50			5.02	
HS	5/20/2003	0.015	0.013	70	0.005	0.01	2.53	
HS	10/28/2003	0.0096	0.0125	44.1	0.0003	0.0035	5.4	
HS	2/5/2004	0.0119	0.0106	46.1	0.0105	0.013	4.79	
HS	5/7/2004	0.0097	0.008	47.6	0.002	0.0124	3.96	
HS	7/21/2004	0.0134	0.0116	46.3	0.0006	0.011	4.9	
HS	9/28/2004	0.017	0.0168	48.1	0.0014	0.011	6.9	
HS	11/9/2004	0.0126	0.0118	45.7	0.0006	0.011	6.3	
HS	5/19/2005	0.0148	0.0145	45.4			3.4	
HS	9/19/2005	0.0135	0.0129	43.8	0.0032	0.0031	8.5	
HS	5/17/2006	0.0189	0.0169	47.1				
HS	5/22/2006	0.0162	0.0173	47.2	0.0033	0.0021	5.9	
HS	6/22/2006	0.0171	0.0168					
HS	9/8/2006	0.0174	0.0174	47.2			5.46	

TABLE 2-6. Concentrations of Total Selenium, Sulfate, Dissolved Iron, Dissolved Manganese, and Dissolved Oxygen in Select Wells, Springs, and Seeps

Location	Sample Date	Selenium, Total (mg/L)	Selenium, Dissolved (mg/L)	Sulfate (mg/L)	Manganese, Dissolved (mg/L)	Iron, Dissolved (mg/L)	Dissolved Oxygen (mg/L)	ORP (mV)
HS	10/16/2006	0.0167	0.016	46.2	0.0015	0.017	5.2	
HS	1/13/2007	0.019	0.0192		0.0015		6.95	
HS	2/23/2007	0.021	0.0208	48			7.43	
HS	3/15/2007	0.0234	0.0214	48			7.46	
HS	4/16/2007	0.0216	0.0221	47.3			7.05	
HS	5/14/2007	0.0002	0.0002	0.053			5.21	51.9
HS	5/15/2007	0.0216	0.0196	48.5			49.7	
HS	5/22/2007	0.0236	0.023	49.4	0.0008	0.0072	8.1	
HS	6/14/2007	0.0228	0.0187				6.68	
HS	7/16/2007	0.0183	0.0162				7.09	
HS	8/13/2007	0.0225	0.022	48.1				
HS	8/24/2007	0.0242	0.0214	46.5			6.32	78.2
HS	9/25/2007	0.0258	0.0234	47.9	0.0008	0.0197	8.8	
HS	11/14/2007	0.0265	0.0236	49.9			6.67	
HS	12/9/2007	0.0247	0.024	47.3			7.37	22
HS	2/14/2008	0.0242	0.0224	49.0			6.68	230.5
HS	3/21/2008	0.0254	0.0252	47.9			7.18	
HS	4/24/2008	0.0316	0.0334	49.4			6.55	
HS	5/17/2008	0.0296	0.0273	49.8			6.08	201.1
HS	5/19/2008	0.0258	0.0326	50	0.0035	0.02	6.31	
HS	5/29/2008	0.025	0.0232	49.7			6.09	
HS	7/27/2008	0.0324	0.0315	50.9			5.48	
HS	8/27/2008	0.0395	0.0355	50.4			5.1	
HS	9/4/2008	0.00065	0.0536	48.1			6.47	89.1
HS	9/17/2008	0.0444	0.0443	48.6			6.98	
HS	10/22/2008	0.0303	0.0285	48.5			8.45	
HS	11/20/2008	0.037	0.0374	51.5	0.0051	0.0202		
HS	11/24/2008	0.0329	0.033	51.3	0.0013		8.2	
HS	12/16/2008	0.0333	0.0327	52			7.46	
HS	1/27/2009	0.0344	0.0331	51.5			7.72	
HS	2/24/2009	0.0359	0.0369	49.7			7.73	
HS	3/31/2009	0.0337	0.033	47.4			9.07	
HS	4/28/2009	0.0358	0.0359	51.3			7.84	
HS	5/31/2009	0.0414	0.0407	50.4	0.0013		5.87	45.6
HS	6/30/2009	0.044	0.0357	51.1			6.42	
HS	7/29/2009	0.0394	0.0394	51.6			5.84	
HS	9/3/2009	0.0413	0.0383	47.1			6.29	
HS	9/28/2009	0.0413	0.0415	49.9			6.56	86.3
HS	10/22/2009	0.0411	0.0406	49.6			5.71	-8.9
HS	11/20/2009	0.04	0.0396	50.1	0.0019		6.38	163
HS	2/23/2010	0.0396	0.0377	50.6				
HS	3/31/2010	0.0442	0.0443	51.9			9.51	174
HS	4/28/2010	0.045	0.0416	47.8			8.65	-39.8
HS	5/26/2010	0.0449	0.0335	51.7			8.59	34.2
HS	6/3/2010	0.0452	0.0447	51.5	0.000449	0.029	5.58	129.6
HS	7/29/2010	0.0446	0.0446	49.4			7.43	16.3
HS	9/7/2010	0.0475	0.0502	49.9			5.6	130.7
HS	11/13/2010	0.0484	0.0478	52.9	0.00055	0.027	7.59	221.7
HS	2/9/2011	0.0475	0.0476	52			8.87	50
HS	6/15/2011	0.0558	0.0532	54.6	0.0017		5.78	-58.6
HS	7/19/2011	0.065	0.0635	49.7			7.74	171.9
HS	8/29/2011	0.0644	0.0639	57.1			7.52	370.6
HS	9/19/2011	0.0667	0.0662	51.4			5.72	274.3
HS	11/10/2011	0.0661	0.0655	51.2	0.0011		5.89	207.26
HS	12/19/2011	0.0687	0.0686	56.2			6.58	197.6
HS	1/31/2012	0.0709	0.071	54.2			8.42	163.5
HS	2/22/2012	0.0763	0.0732	54.4			8.19	192
HS	3/23/2012	0.0682	0.0659	55.9			9.32	144.3

TABLE 2-6. Concentrations of Total Selenium, Sulfate, Dissolved Iron, Dissolved Manganese, and Dissolved Oxygen in Select Wells, Springs, and Seeps

Location	Sample Date	Selenium, Total (mg/L)	Selenium, Dissolved (mg/L)	Sulfate (mg/L)	Manganese, Dissolved (mg/L)	Iron, Dissolved (mg/L)	Dissolved Oxygen (mg/L)	ORP (mV)
HS	4/25/2012	0.0754	0.0724	56			7.57	28.3
HS	5/9/2012	0.0696	0.0695	52.1	0.0019		5.76	151.4
HS	6/21/2012	0.0796	0.0778	55			5.29	97.8
HS	7/23/2012	0.0835	0.0819	56.5			6.58	
HS	8/28/2012	0.0874	0.0815	53.3			5	110.5
HS	9/12/2012	0.0783	0.0751	56.8	0.00056		7.46	79.1
HS	10/29/2012	0.0722	0.0702	56.3			11.09	-24.5
HS	11/13/2012	0.0791	0.0746	53.9	0.00028		5.29	119.2
HS	12/18/2012	0.0815	0.0816	55.6			6.04	199.3
HS	1/29/2013	0.0897	0.0894	57.8			8.35	38
HS	2/25/2013	0.0858	0.0861	57.7			8.47	315.6
HS	3/27/2013	0.0863	0.083	60.7			8.88	247.4
HS	4/25/2013	0.0937	0.0919	58.5			8.2	216
HS	5/20/2013	0.0898	0.0836	57.3	0.00024		6.04	160
HS	6/27/2013	0.089	0.0866	57			7.65	-57
HS	8/23/2013	0.0918	0.0891	56.5			5.72	60.2
HS	11/13/2013	0.095	0.0926	58.6	0.00027		5.83	79.2
HS	3/12/2014	0.0955	0.0935	58.1				
HS	5/19/2014	0.107	0.104	59.1	0.00032		6.18	93.5
HS	8/8/2014	0.101	0.104	58.5			4.91	74.3
HS	11/17/2014	0.104	0.104	60.1	0.004	0.023	6.39	237.5
HS	3/10/2015	0.111	0.11	61.1			5.41	77
HS	5/7/2015	0.134	0.133	61.1	0.00067	0.026	9.13	136.9
HS	7/22/2015	0.116	0.116	64.3	0.003	0.048	4.71	97.8
HS	9/10/2015	0.114	0.112	63.3	0.0012	0.048	4.92	100.8
HS	11/4/2015	0.11	0.111	55.7	0.0015	0.048	6.04	114.2
HS	3/16/2016	0.128	0.13	56.3			5.08	65.1
HS	5/17/2016	0.121	0.121	60.9	0.00056	0.048	4.37	59.3
HS	7/7/2016	0.119	0.118	66.6	0.00038	0.039	5.66	86.2
HS	11/8/2016	0.121	0.121	61.1	0.00041	0.039	5.33	140.7
HS	3/21/2017	0.117	0.119	58.1			5	125.6
HS	5/16/2017	0.125	0.122	65	0.00121		4.29	85.7
HS	8/1/2017	0.113	0.11	65			4.55	51.4
HS	11/14/2017	0.122	0.128	65.9	0.000765		4.7	100.4
HS	3/12/2018	0.133	0.137	63.1			5	75.8
HS	5/16/2018	0.122	0.136	69.4	0.000512		10.01	233.1
HS	8/9/2018	0.13	0.13	59.2	0.000511		4.51	177
HS	10/25/2018	0.137	0.133	66.1	0.000293		4.43	180.4
HS	2/25/2019	0.14	0.145	67.7	0.000274	0.056	4.39	100.2
HS-C1	5/17/2006	0.0168	0.014	42.6				
HS-C1	6/2/2008	0.0237	0.0228	47.4			6.19	
HS-C1	8/27/2008	0.0331	0.0315	47.6			6.58	
HS-C1	9/17/2008	0.0436	0.0408	44.5			8.37	
HS-C1	10/22/2008	0.0312	0.0288	44.6			8	
HS-C1	11/24/2008	0.0344	0.0342	44.6			7.88	
HS-C1	12/16/2008	0.0353	0.031	49.1			7.24	
HS-C1	1/27/2009	0.0363	0.0329	48.2			7.11	
HS-C1	2/24/2009	0.0095	0.0287	40.9			7.51	
HS-C1	3/31/2009	0.0367	0.0348	44.2			7.67	
HS-C1	4/28/2009	0.0379	0.0378	47.6			7.76	
HS-C1	5/31/2009	0.0423	0.0398	47.8			7.16	
HS-C1	6/30/2009	0.0441	0.0388	48.6			6.91	
HS-C1	7/29/2009	0.0387	0.0401	50.5			6	
HS-C1	9/3/2009	0.0409	0.0384	44			6.67	
HS-C1	9/28/2009	0.0403	0.0423	47.9	0.0019		7.54	47
HS-C1	10/22/2009	0.0419	0.0394	45.7			5.82	2.2
HS-C1	11/20/2009	0.0408	0.0415	48.6			5.5	206.7
HS-C1	2/23/2010	0.0405	0.0385	49.4				

TABLE 2-6. Concentrations of Total Selenium, Sulfate, Dissolved Iron, Dissolved Manganese, and Dissolved Oxygen in Select Wells, Springs, and Seeps

Location	Sample Date	Selenium, Total (mg/L)	Selenium, Dissolved (mg/L)	Sulfate (mg/L)	Manganese, Dissolved (mg/L)	Iron, Dissolved (mg/L)	Dissolved Oxygen (mg/L)	ORP (mV)
HS-C1	3/31/2010	0.0451	0.0454	48.3			8.67	96.1
HS-C1	4/28/2010	0.0433	0.0453	44.3			8.21	-36.1
HS-C1	5/26/2010	0.0485	0.0466	49.9			8.13	27.5
HS-C1	6/3/2010	0.0492	0.048	49.9	0.000533	0.018	7.86	32
HS-C1	7/29/2010	0.0503	0.0509	46.7			6.97	-6.2
HS-C1	9/7/2010	0.059	0.0563	48.1			5	226
HS-C1	11/13/2010	0.0541	0.0545	48.7	0.00039	0.027	6.35	218.3
HS-C1	2/9/2011	0.0518	0.0513	49.4			8.13	52.8
HS-C1	6/15/2011	0.0527	0.0526	48			5.34	2.1
HS-C1	7/19/2011	0.0617	0.0606	46.8			7.7	231.1
HS-C1	8/29/2011	0.0686	0.0681	50.1			7.4	396.1
HS-C1	9/19/2011	0.0737	0.0742	48.7			5.46	200.9
HS-C1	11/10/2011	0.067	0.0668	46.8			5.28	207.45
HS-C1	12/19/2011	0.0799	0.0796	52.6			6.32	208.4
HS-C1	1/31/2012	0.0785	0.0761	48.9			8.09	219.6
HS-C1	2/22/2012	0.0653	0.0631	47.6			8.05	192.7
HS-C1	3/23/2012	0.0832	0.0764	52.3			8.85	119.5
HS-C1	4/25/2012	0.0831	0.0824	51.9			7.51	40.9
HS-C1	5/9/2012	0.0854	0.0852	48.9			5.92	233.7
HS-C1	6/21/2012	0.0861	0.0866	49.9			5.68	116.5
HS-C1	7/23/2012	0.0899	0.0894	52			7.7	157.1
HS-C1	8/28/2012	0.0978	0.0997	50.4			5.08	71.5
HS-C1	9/12/2012	0.075	0.0724	50.1	0.00018		7.42	61.8
HS-C1	10/29/2012	0.0709	0.0707	50.2			10.97	-24
HS-C1	11/13/2012	0.0806	0.0761	49.9			10.06	-17.1
HS-C1	12/18/2012	0.0911	0.0913	50.8			5.9	231.8
HS-C1	1/29/2013	0.0993	0.0964	53.4				
HS-C1	2/25/2013	0.101	0.102	53.8			8.23	322
HS-C1	3/27/2013	0.0856	0.0867	56.4			8.5	254.9
HS-C1	4/25/2013	0.106	0.104	56.8			8.06	219.6
HS-C1	5/20/2013	0.0972	0.0957	53.5			5.97	239.9
HS-C1	6/27/2013	0.0967	0.095	53.3			8.11	-57.3
HS-C1	8/23/2013	0.0813	0.0786	49.4			5.93	149.4
HS-C1	11/13/2013	0.0871	0.0869	51			6.21	134.3
HS-C1	3/12/2014	0.102	0.101	54.9				
HS-C1	5/19/2014	0.106	0.106	52.5			6.36	88.6
HS-C1	8/8/2014	0.1	0.104	53.1			5.55	101.1
HS-C1	11/17/2014	0.104	0.0957	54.9			5.36	258
HS-C1	3/10/2015	0.112	0.112	54.1			5.96	67.2
HS-C1	5/7/2015	0.111	0.11	53.9			7.89	130.2
HS-C1	9/10/2015	0.122	0.129	55.7			5.75	124.8
HS-C1	11/4/2015	0.12	0.112	54.8			5.89	109.8
HS-C1	3/16/2016	0.12	0.12	63.3			4.9	68.9
HS-C1	5/18/2016	0.131	0.13	56.5			5.22	-49.5
HS-C1	7/7/2016	0.117	0.119	62.5			6.37	88.5
HS-C1	11/8/2016	0.125	0.125	55.1			5.58	137.5
HS-C1	3/21/2017	0.117	0.119	63.5			4.49	102.9
HS-C1	5/16/2017	0.124	0.136	59.9			5.08	78.9
HS-C1	8/1/2017	0.131	0.128	61.9			5.26	55.9
HS-C1	11/14/2017	0.135	0.144	60.5			5.2	96.9
HS-C1	3/12/2018	0.121	0.125	70			4.75	71.3
HS-C1	5/16/2018	0.137	0.153	61			12.83	222.6
HS-C1	8/9/2018	0.14	0.137	53.6			5.57	148.6
HS-C1	10/25/2018	0.153	0.147	59.9			5.02	166.3
HS-C1	2/25/2019	0.16	0.154	61.7	0.000288	0.056	4.61	99

TABLE 2-6. Concentrations of Total Selenium, Sulfate, Dissolved Iron, Dissolved Manganese, and Dissolved Oxygen in Select Wells, Springs, and Seeps

Location	Sample Date	Selenium, Total (mg/L)	Selenium, Dissolved (mg/L)	Sulfate (mg/L)	Manganese, Dissolved (mg/L)	Iron, Dissolved (mg/L)	Dissolved Oxygen (mg/L)	ORP (mV)
LP-1	8/15/1997	0.68		290	0.02	0.0037		
LP-1	10/28/2003	0.872	0.723	459	0.0027	0.0035	6	
LP-1	2/4/2004	1.5	1.5	682	0.0047	0.013	6.7	
LP-1	5/7/2004	1.22	0.505	368	0.0036	0.0174	6.97	
LP-1	7/20/2004						7.61	
LP-1	11/8/2004	0.789	0.787	356	0.0006	0.011	7.94	
LP-1	12/1/2005	1.89	1.38	512				
LP-1	5/21/2006	0.992		232			8.7	
LP-1	6/22/2006	0.682	0.628					
LP-1	5/22/2007	0.804		228			8.8	
LP-1	5/19/2008	5.01	6.23	1160	0.0006	0.02	9.54	
LP-1	9/16/2008	4.33	4.26	1340			10.05	
LP-1	6/2/2009	7.24	7.13	1460			8.45	218.9
LP-1	7/29/2009	5.81	5.79	1700			6.46	
LP-1	10/21/2009	5.29	4.18	1590			10.37	76.6
LP-1	4/28/2010	4.38	3.98	1450			12.21	-18.6
LP-1	6/8/2010	6.26	5.81	1640	0.000471	0.018	8.09	156.8
LP-1	5/17/2011	7.014	6.479				11.04	49.5
LP-1	6/1/2011	4.648	4.139	1299			11.58	54.6
LP-1	6/4/2011	4.255	4.219	1136			11.76	48.6
LP-1	6/5/2011	4.178	3.804	1066			11.81	24
LP-1	6/7/2011	5.132	4.503	1100			11.3	39.7
LP-1	6/9/2011	5.268	4.725	1120				
LP-1	6/12/2011	3.602	3.335	1032				
LP-1	6/14/2011	3.6	3.53	738	0.0028	0.017	11.51	202.6
LP-1	6/21/2011	6.518	6.281	1229			8.07	133.5
LP-1	6/27/2011	6.84	6.24	1374				
LP-1	8/17/2011	5.22	5.24	1210			10.59	170.5
LP-1	9/20/2011	4.82	4.76	1450	0.0015	0.0172	7.68	194.3
LP-1	11/7/2011	4.33	4.04	1590	0.00095	0.0172	8.68	170
LP-1	4/25/2012	6.62	5.98	1630	0.00071	0.022	10.96	58.5
LP-1	5/11/2012	5.93	5.96	1640	0.0005	0.022	7.57	215.3
LP-1	6/21/2012	5.03	4.83	1660	0.0012	0.022	7.19	119.7
LP-1	7/23/2012	4.4	4.18	1710	0.0052	0.019	8	160.6
LP-1	5/21/2013	4.9	4.53	1750			11.25	179.8
LP-1	4/24/2014						11.18	40.7
LP-1	4/29/2014	6.85	6.83	1680				
LP-1	5/20/2014	6.84	6.76	1700			8.74	89
LP-1	8/12/2014	6.26	6.44	1900			8.91	79.4
LP-1	11/20/2014	4.3	4.35	1880			7.43	258.1
LP-1	5/8/2015	7.18	5.59	1730			9.46	147.9
LP-1	9/12/2015	4.6	4.57	1850			6.85	184
LP-1	11/5/2015	3.87	3.78	1750			11.73	227.4
LP-1	5/18/2016	5.78	5.66	1790			7.55	-37.7
LP-1	7/8/2016	4.03	4.02	1910			8.72	241.6
LP-1	11/7/2016	3.97	3.88	1740			0.93	35.2
LP-1	5/15/2017	3.72	3.79	1690			5.91	119.3
LP-1	8/1/2017	4.12	4.03	1800			5.46	25
LP-1	11/13/2017	3.31	2.85	1730			7.9	163
LP-1	5/18/2018	4.91	5.31	1800			10.11	198
LP-1	10/22/2018	2.44	2.41	1870			6.41	219.1

TABLE 2-6. Concentrations of Total Selenium, Sulfate, Dissolved Iron, Dissolved Manganese, and Dissolved Oxygen in Select Wells, Springs, and Seeps

Location	Sample Date	Selenium, Total (mg/L)	Selenium, Dissolved (mg/L)	Sulfate (mg/L)	Manganese, Dissolved (mg/L)	Iron, Dissolved (mg/L)	Dissolved Oxygen (mg/L)	ORP (mV)
LSS-SP-S1	10/10/2007	0.004	0.004	12.4			5.2	
LSS-SP-S1	11/19/2007	0.0032	0.0033	12.3			5.42	85
LSS-SP-S1	12/14/2007	0.0032	0.0032	11.9			4.87	214
LSS-SP-S1	3/21/2008	0.0028	0.0028	12.0			5.14	
LSS-SP-S1	4/24/2008	0.00208	0.00284	11.8			5.22	
LSS-SP-S1	5/29/2008	0.0035	0.0033	15.3			5.2	
LSS-SP-S1	7/27/2008	0.0046	0.0045	8.99			5.42	
LSS-SP-S1	8/27/2008	0.0053	0.0051	14.4			5.25	
LSS-SP-S1	9/17/2008	0.0056	0.0056	12.9			6.62	
LSS-SP-S1	10/22/2008	0.0046	0.0045	12.6			6.58	
LSS-SP-S1	11/24/2008	0.0046	0.0045	12.5			5.98	
LSS-SP-S1	1/27/2009	0.0046	0.0046	13.9			5.83	
LSS-SP-S1	2/24/2009	0.004	0.0042	12.1			6.27	
LSS-SP-S1	3/31/2009	0.0036	0.0035	11.9	0.0013		6.92	
LSS-SP-S1	4/28/2009	0.0044	0.0044	12.9			6.61	
LSS-SP-S1	5/31/2009	0.0036	0.0033	13.6	0.0013		6.56	
LSS-SP-S1	6/28/2009	0.0039	0.0038	13.4			7.05	
LSS-SP-S1	7/28/2009	0.0045	0.0045	14.1			6.73	
LSS-SP-S1	9/3/2009	0.0038	0.0034	12.4			5.51	
LSS-SP-S1	9/28/2009	0.0041	0.0042	13.6	0.0019		6.15	170.9
LSS-SP-S1	10/22/2009	0.0012	0.00086	14.6			4.05	-2.4
LSS-SP-S1	11/20/2009	0.0015	0.0013	15.2	0.0019		3.88	216.1
LSS-SP-S1	2/23/2010	0.0038	0.0037	13.3				
LSS-SP-S1	3/31/2010	0.0038	0.0038	13			6.82	147
LSS-SP-S1	4/28/2010	0.0027	0.0028	11.2			6.28	-41.6
LSS-SP-S1	5/26/2010	0.004	0.004	12.8			7.76	48.1
LSS-SP-S1	6/3/2010	0.0049	0.0049	13	0.000062	0.018	6.57	11.3
LSS-SP-S1	7/29/2010	0.005	0.005	12.4			6.29	-2.5
LSS-SP-S1	9/8/2010	0.0078	0.0074	13.3	0.0017		4.56	121.7
LSS-SP-S1	10/27/2010	0.0055	0.0054	13.3				
LSS-SP-S1	11/10/2010	0.0051	0.0052	12.7	0.00043	0.027	5.48	252.3
LSS-SP-S1	2/9/2011	0.0028	0.0022	12.9			6.36	51.5
LSS-SP-S1	6/15/2011	0.0026	0.0026	12.2	0.0011		6.53	125.3
LSS-SP-S1	7/19/2011	0.0061	0.0061	12.7			6.52	176.6
LSS-SP-S1	8/29/2011	0.007	0.0068	13.5			6.39	324.9
LSS-SP-S1	9/19/2011	0.0036	0.0035	12.1			4.96	226.2
LSS-SP-S1	11/7/2011	0.0029	0.003	11.9	0.0011		4.53	330.4
LSS-SP-S1	12/19/2011	0.0069	0.0061	13.2			5.19	172.8
LSS-SP-S1	2/22/2012	0.0046	0.0043	12.4			6.25	179.5
LSS-SP-S1	3/23/2012	0.0051	0.005	13.4	0.0011		6.95	125.5
LSS-SP-S1	4/25/2012	0.0042	0.0039	12.7			6.17	55.6
LSS-SP-S1	5/9/2012	0.0034	0.0035	11.8	0.000069		4.4	177.7
LSS-SP-S1	6/21/2012	0.0031	0.0029	12.3			4.97	133.7
LSS-SP-S1	7/30/2012	0.006	0.006	13.5			6.42	60.9
LSS-SP-S1	8/28/2012	0.0064	0.0064	13	0.00042		4.29	141.5
LSS-SP-S1	9/12/2012	0.0045	0.0044	12.8			6.7	90.9
LSS-SP-S1	10/29/2012	0.0062	0.0059	13.4			9.54	-21.5
LSS-SP-S1	11/13/2012	0.0075	0.0076	12.8	0.00041		4.27	177.1
LSS-SP-S1	12/19/2012	0.0073	0.0073	13			4.97	203.8
LSS-SP-S1	2/25/2013	0.0025	0.0026	12.6			6.93	318.5
LSS-SP-S1	3/27/2013	0.0032	0.0031	13.2	0.000042		7.02	276.2
LSS-SP-S1	4/25/2013	0.004	0.0039	13			6.81	233.3
LSS-SP-S1	5/20/2013	0.0038	0.0038	11.2	0.00086		4.69	235.3
LSS-SP-S1	6/27/2013	0.0068	0.0068	13.2			7.08	-56.6
LSS-SP-S1	9/23/2013	0.0087	0.0078	12.7	0.00053		4.43	44.7
LSS-SP-S1	11/13/2013	0.0069	0.007	13.4	0.00086		4.73	228.7
LSS-SP-S1	3/12/2014	0.0049	0.0046	11.9			4.85	52.1
LSS-SP-S1	5/19/2014	0.0068	0.0068	12.4	0.00013		5.27	101.6

TABLE 2-6. Concentrations of Total Selenium, Sulfate, Dissolved Iron, Dissolved Manganese, and Dissolved Oxygen in Select Wells, Springs, and Seeps

Location	Sample Date	Selenium, Total (mg/L)	Selenium, Dissolved (mg/L)	Sulfate (mg/L)	Manganese, Dissolved (mg/L)	Iron, Dissolved (mg/L)	Dissolved Oxygen (mg/L)	ORP (mV)
LSS-SP-S1	8/8/2014	0.0017	0.0017	13.2			4.93	68.6
LSS-SP-S1	11/17/2014	0.0039	0.0038	11.2	0.00042		5.01	290.1
LSS-SP-S1	3/10/2015	0.003	0.003	12.3			5.5	75.7
LSS-SP-S1	5/7/2015	0.0035	0.0038	12.2	0.00014		7.04	113
LSS-SP-S1	9/10/2015	0.0065	0.0065	13.4			4.61	167.2
LSS-SP-S1	11/4/2015	0.0043	0.0038	11.4	0.00033		2.44	80.6
LSS-SP-S1	3/16/2016	0.0034	0.0038	12.6			5.76	53.5
LSS-SP-S1	5/18/2016	0.0038	0.0036	11.8	0.000436		4.78	-51.4
LSS-SP-S1	7/7/2016	0.0024	0.0023	15.1			5.06	55.4
LSS-SP-S1	11/8/2016	0.0078	0.0082	12.9	0.000198		5.54	127.1
LSS-SP-S1	3/21/2017	0.0044	0.0037	12.8			5.58	96.6
LSS-SP-S1	5/16/2017	0.0043	0.0048	12.6	0.000267		4.9	234.5
LSS-SP-S1	8/1/2017	0.0109	0.0108	13.7			5.7	133.8
LSS-SP-S1	11/14/2017	0.0066	0.0071	14.3	0.000111		4.7	102.6
LSS-SP-S1	3/12/2018	0.0057	0.0059	15.9			4.88	67.8
LSS-SP-S1	5/17/2018	0.0044	0.0045	14.1	0.000132		7.47	125.7
LSS-SP-S1	8/8/2018	0.008	0.008	11.5			4.8	163.7
LSS-SP-S1	10/22/2018	0.0034	0.0034	13.2	0.000131		4.8	198.5
LSS-SP-S1	3/29/2019	0.0054	0.0062	12.1			4.98	127
LSS-SP-S2	10/10/2007	0.0016	0.0016	15.8			4.93	
LSS-SP-S2	11/19/2007	0.0011	0.0012	15.6			5.19	115
LSS-SP-S2	12/14/2007	0.0013	0.0013	15.3			4.8	225
LSS-SP-S2	3/21/2008	0.0011	0.001	15.629			5.12	
LSS-SP-S2	4/24/2008	0.0014	0.0017	15.7			5.27	
LSS-SP-S2	5/29/2008	0.0014	0.0012	19.4			4.94	
LSS-SP-S2	7/27/2008	0.0018	0.0018	17.6			5.18	
LSS-SP-S2	8/27/2008	0.0021	0.0018	17			5.1	
LSS-SP-S2	9/17/2008	0.0025	0.0025	15.3			6.48	
LSS-SP-S2	10/22/2008	0.0035	0.0021	15.5			6.12	
LSS-SP-S2	11/24/2008	0.0014	0.0013	15.3			5.98	
LSS-SP-S2	1/27/2009	0.002	0.0015	15.8			5.38	
LSS-SP-S2	2/24/2009	0.0017	0.0017	16			6.16	
LSS-SP-S2	3/31/2009	0.00099	0.00098	14.1	0.0013		6.33	
LSS-SP-S2	4/28/2009	0.0019	0.0018	16			6.23	
LSS-SP-S2	5/31/2009	0.0013	0.0008	16.8	0.0013		6.4	
LSS-SP-S2	6/28/2009	0.0012	0.0016	16.3			5.71	
LSS-SP-S2	7/28/2009	0.0014	0.0015	16.9			6.11	
LSS-SP-S2	9/3/2009	0.0014	0.0012	14.4			5.4	
LSS-SP-S2	9/28/2009	0.0013	0.0014	16.7	0.002		5.83	190
LSS-SP-S2	10/22/2009	0.0015	0.0014	15.7			452	2.7
LSS-SP-S2	11/20/2009	0.0014	0.0014	16.3	0.0019		4.31	224.2
LSS-SP-S2	2/23/2010	0.0013	0.0013	16.4				
LSS-SP-S2	3/31/2010	0.0016	0.0016	16.1			6.82	152.2
LSS-SP-S2	4/28/2010	0.0014	0.0014	13.8			5.97	-45.5
LSS-SP-S2	5/26/2010	0.0021	0.0011	15.9			6.13	45.5
LSS-SP-S2	6/3/2010	0.0016	0.0014	15.5	0.000126	0.018	6.18	11.2
LSS-SP-S2	7/29/2010	0.0016	0.0015	14.9			5.96	12.7
LSS-SP-S2	9/8/2010	0.0012	0.0012	15.4	0.0017		4.09	137.8
LSS-SP-S2	10/27/2010	0.0014	0.0016	16.1				
LSS-SP-S2	11/10/2010	0.0016	0.0016	15.5	0.00043	0.027	4.35	191.8
LSS-SP-S2	2/9/2011	0.0013	0.0013	15.5			6.17	75.7
LSS-SP-S2	6/15/2011	0.0013	0.0013	15.3	0.0011		6.6	115.7
LSS-SP-S2	7/19/2011	0.0014	0.0014	14.7			6.43	162.8
LSS-SP-S2	8/29/2011	0.0016	0.0015	15.3			6.24	281.9
LSS-SP-S2	9/19/2011	0.0012	0.0013	14.4			4.48	222.7
LSS-SP-S2	11/7/2011	0.0014	0.0014	15.1	0.0011		6.23	217
LSS-SP-S2	12/19/2011	0.0013	0.0011	15.6			5.11	179.4
LSS-SP-S2	2/22/2012	0.0014	0.0012	15			6.47	163.2

TABLE 2-6. Concentrations of Total Selenium, Sulfate, Dissolved Iron, Dissolved Manganese, and Dissolved Oxygen in Select Wells, Springs, and Seeps

Location	Sample Date	Selenium, Total (mg/L)	Selenium, Dissolved (mg/L)	Sulfate (mg/L)	Manganese, Dissolved (mg/L)	Iron, Dissolved (mg/L)	Dissolved Oxygen (mg/L)	ORP (mV)
LSS-SP-S2	3/23/2012	0.0014	0.0013	16	0.0011		7.38	154
LSS-SP-S2	4/25/2012	0.0017	0.0018	15.4			6.16	75.9
LSS-SP-S2	5/9/2012	0.0012	0.0012	14.4	0.00026		4.53	185.3
LSS-SP-S2	6/21/2012	0.0014	0.0013	15.1			5.17	114.1
LSS-SP-S2	7/30/2012	0.0018	0.0015	15.9			6.77	69.2
LSS-SP-S2	8/28/2012	0.0014	0.0012	15.3	0.00055		4.39	157.7
LSS-SP-S2	9/12/2012	0.0012	0.0011	15.8			6.7	90.1
LSS-SP-S2	10/29/2012	0.0012	0.0011	15.7			9.16	-22.2
LSS-SP-S2	11/13/2012	0.0018	0.0017	15.1	0.00023		8.35	-12.7
LSS-SP-S2	12/19/2012	0.0013	0.0011	15			4.73	199
LSS-SP-S2	2/25/2013	0.0012	0.0012	15			7.05	313.2
LSS-SP-S2	3/27/2013	0.0014	0.0013	15.9	0.00015		7.11	270.9
LSS-SP-S2	4/25/2013	0.0012	0.0012	15.7			7.16	237.6
LSS-SP-S2	5/20/2013	0.0012	0.0012	14.8	0.00068		4.86	230
LSS-SP-S2	6/27/2013	0.0015	0.0015	15.6			7.18	-61.4
LSS-SP-S2	9/23/2013	0.0015	0.0015	15.2	0.00043		4.13	45.2
LSS-SP-S2	11/13/2013	0.0019	0.0014	16	0.00088		4.55	217.5
LSS-SP-S2	3/12/2014	0.0013	0.0013	15.2			4.74	52.8
LSS-SP-S2	5/19/2014	0.0018	0.0014	14.4	0.000019		5.09	95.9
LSS-SP-S2	8/8/2014	0.0015	0.0015	15.3			5.01	72.7
LSS-SP-S2	11/17/2014	0.0016	0.0012	14.6	0.00022		4.66	29.6
LSS-SP-S2	3/10/2015	0.0013	0.0014	15.3			5.17	72.9
LSS-SP-S2	5/7/2015	0.0017	0.0017	15.7	0.00012		6.67	114.3
LSS-SP-S2	9/10/2015	0.0013	0.0015	16.5			4.68	159.3
LSS-SP-S2	11/4/2015	0.0014	0.0013	14.6	0.000069		2.52	68.3
LSS-SP-S2	3/16/2016	0.0013	0.0014	16.1			5.16	54.1
LSS-SP-S2	5/18/2016	0.0013	0.0014	15.4	0.000119		4.19	-58.4
LSS-SP-S2	7/7/2016	0.0013	0.0013	18			4.83	46.8
LSS-SP-S2	11/8/2016	0.0014	0.0012	15.3	0.000326		5.06	132.3
LSS-SP-S2	3/21/2017	0.0011	0.001	16			5.27	98
LSS-SP-S2	5/16/2017	0.0012	0.0013	15.4	0.000297		6.04	212.4
LSS-SP-S2	8/1/2017	0.0013	0.0013	17			5.04	80.4
LSS-SP-S2	11/14/2017	0.0012	0.0013	16.9	0.000129		4.92	101.4
LSS-SP-S2	3/12/2018	0.0012	0.0012	17.5			5.29	69.8
LSS-SP-S2	5/17/2018	0.0013	0.0013	16.9	0.0067		7.53	129.3
LSS-SP-S2	8/8/2018	0.0012	0.0011	14.5			5.21	167.8
LSS-SP-S2	10/22/2018	0.0011	0.0012	14.7	0.000295		4.62	216.5
LSS-SP-S2	3/29/2019	0.0012	0.0014	14.6			5.06	112.3

Notes:

mg/L = miligrams per liter

mV = milivolts

TABLE 3-1. Detailed Analysis of Remedial Alternatives for Wells Formation Groundwater

	Alternative WG-1 No Further Action	Alternative WG-3 Institutional Controls (ICs)	Alternative WG-5 Capillary Covers, ICs and MNA	Alternative WG-7 Geomembrane Covers, ICs and MNA
Threshold Criteria				
1. Protection of Human Health and the Environment				
Detailed Analysis	***Low***	***High***	***High***	***High***
Protection of Human Health	Human health would not be protected because the use of Wells Formation groundwater with selenium concentrations above the MCL as a source of drinking water would not be prevented.	Future residential development and use of Wells Formation groundwater is not a potential land use for Forest Service land. The adjacent area is owned by Simplot. Human health would be protected because ICs (deed restrictions) would prevent the use of Wells Formation groundwater with selenium concentrations above the MCL as a source of drinking water. Deed restrictions would only be applied to areas where selenium concentrations exceed the MCL and would be ultimately be removed when the MCL is met throughout Simplot-owned land in Sage Valley.	Same as Alternative WG-3.	Same as Alternative WG-3.
Protection of the Environment	There are no ecological risks directly associated with Wells Formation groundwater.	Same as Alternative WG-1.	Same as Alternative WG-1.	Same as Alternative WG-1.
2. Compliance With ARARs				
Detailed Analysis	***Moderate***	***Moderate***	***Moderate to High***	***Moderate to High***
Chemical-Specific ARARs	Under current conditions, selenium concentrations in Wells Formation groundwater downgradient of the Pole Canyon ODA (i.e., GW-16) and downgradient of Panel E (i.e., GW-25) are above the MCL, and represent exceedances of a chemical-specific ARAR. Mass flux of selenium from the ODAs to Wells Formation groundwater is predicted to decrease over time as the effects of releases during active mining diminish, because of the effects of subsequent reclamation/NTCRA actions and source depletion. This would result in a decrease in selenium concentrations over time; however, it is uncertain whether selenium concentrations in Wells Formation groundwater will ultimately reduce below the MCL at monitoring wells downgradient of the mine.	Selenium concentrations in Wells Formation groundwater would decrease at the same rate as Alternative WG-1.	Mass flux of selenium from the ODAs to Wells Formation groundwater is expected to decrease over time, which would result in a decrease in selenium concentrations. With installation of capillary covers, the reduction in infiltration for an average precipitation year is estimated to be 58%. Selenium concentrations would reduce more quickly than for Alternative WG-3 with the addition of covers on the target areas; however, it is uncertain when selenium concentrations in Wells Formation groundwater will ultimately reduce below the MCL at monitoring wells downgradient of the mine.	Mass flux of selenium from the ODAs to Wells Formation groundwater is expected to decrease over time, which would result in a decrease in selenium concentrations. With installation of geomembrane covers, the reduction in infiltration for an average precipitation year is estimated to be 100%. Selenium concentrations would likely reduce more quickly than for Alternative WG-3 with the addition of covers on the target areas.
Location- and Action-Specific ARARs	Because there is no further action, no location- or action-specific ARARs would be triggered.	No location- or action-specific ARARs would be triggered by ICs.	Location- and action-specific ARARs would be triggered for reclamation of mined areas and control of fugitive dust during construction of the covers. The requirements would be met by remedial design.	Same as Alternative WG-5.
Balancing Criteria				
3. Long Term Effectiveness and Permanence				
Detailed Analysis	***Low***	***Moderate***	***Moderate to High***	***Moderate to High***
Magnitude of Residual Risk	The Groundwater Model simulation indicates that mass flux of selenium from the ODAs to Wells Formation groundwater will reduce over time. As the mass flux decreases it is expected to result in a general reduction in selenium concentrations in groundwater, with specific effects being dependent on the physical location of the well screen relative to source areas and groundwater flow paths dictated by stratigraphic and structural conditions. While groundwater conditions are expected to improve over time, it is uncertain whether selenium concentrations will ultimately reduce to below the MCL at all monitoring locations. Residual risks would remain related to the potential for use of Wells Formation groundwater as a drinking water source on a portion of Simplot-owned land downgradient of the Pole Canyon ODA. The remaining source of risk is residual contamination in ODAs that is released to Wells Formation groundwater.	The potential for use of Wells Formation groundwater as a drinking water source would be eliminated by ICs. The area of groundwater with selenium concentrations above the MCL would reduce over time as the source controls associated with reclamation covers and the Pole Canyon NTCRAs have greater effect, selenium associated with active mining exits the system and source depletion occurs. The remaining source of risk is residual contamination in ODAs that is released to Wells Formation groundwater. CERCLA 5-year reviews would be required.	The potential for use of Wells Formation groundwater as a drinking water source would be eliminated by ICs. The area of groundwater with selenium concentrations above the MCL would reduce over time as the source controls associated with reclamation covers and the Pole Canyon NTCRAs have greater effect, selenium associated with active mining exits the system and source depletion occurs. Installing capillary covers on the target areas would reduce infiltration of water into overburden in this area and subsequent release of selenium to Wells Formation groundwater, thereby reducing residual risk. CERCLA 5-year reviews would be required.	Same as Alternative WG-5.
Adequacy and Reliability of Controls	No controls would be implemented.	Simplot owns the land and ICs would be adequate to restrict human exposures to Wells Formation groundwater. No long-term O&M or monitoring would be required.	Installation of capillary covers over the target areas would be an adequate and reliable containment system that would be viable over the long term. Cover construction is straightforward and the covers would be likely to meet performance specifications. Capillary covers would require inspections and long-term O&M. The cover would be constructed of natural materials that would be viable and long lasting and would not likely need to be replaced. Long-term monitoring of Wells Formation groundwater would be required.	Installation of geomembrane covers over the target areas would be an adequate and reliable containment system. Geomembrane covers can be constructed using specialized construction techniques and would be likely to meet performance specifications. Long-term monitoring of Wells Formation groundwater would be required.

TABLE 3-1. Detailed Analysis of Remedial Alternatives for Wells Formation Groundwater

	Alternative WG-1 No Further Action	**Alternative WG-3 Institutional Controls (ICs)**	**Alternative WG-5 Capillary Covers, ICs and MNA**	**Alternative WG-7 Geomembrane Covers, ICs and MNA**
Threshold Criteria				
4. Reduction of Toxicity, Mobility, or Volume Through Treatment				
Detailed Analysis	***Low***	***Low***	***Low***	***Low***
Treatment Process Used and Materials Treated	None.	None.	None.	None.
Amount of Hazardous Materials Destroyed or Treated	None.	None.	None.	None.
Degree of Expected Reductions in Toxicity, Mobility, and Volume	None.	None.	None.	None.
Degree to Which Treatment is Irreversible	No treatment.	No treatment.	No treatment.	No treatment.
Type and Quantity of Treatment Residuals Remaining After Treatment	None.	None.	None.	None.
Statutory Preference for Treatment as a Principal Element	Alternative WG-1 does not satisfy the statutory preference for treatment.	Alternative WG-3 does not satisfy the statutory preference for treatment.	Alternative WG-5 does not satisfy the statutory preference for treatment.	Alternative WG-7 does not satisfy the statutory preference for treatment.
5. Short-Term Effectiveness				
Detailed Analysis	***Moderate***	***High***	***High***	***High***
Protection of Community During Remedial Actions	No additional actions would be implemented.	No physical remedial action would be performed and therefore there is no potential for risk to the community during implementation.	There would be no increased risk to local communities during remediation activities because it is anticipated that borrow materials needed to construct the covers are available at or near the mine.	Same as Alternative WG-5.
Protection of Workers During Remedial Actions	No additional actions would be implemented.	No physical remedial action would be performed and therefore there is no potential for risk to workers during implementation.	Risk of construction worker exposure to dust and overburden material during remedial construction activities would be mitigated using standard health and safety protocols and BMPs. Construction associated with the covers would pose low risk to workers, because they are performed with standard construction techniques and have a demonstrated high level of safety when performed with appropriate safety precautions and procedures. Workers would be protected by having OSHA and HAZWOPER training, wearing appropriate PPE and by following established health and safety procedures and protocols. O&M activities are routine and would present a low risk to workers.	Same as Alternative WG-5.
Environmental Impacts Expected with Construction and Implementation of Remedial Actions	No additional actions would be implemented.	No physical remedial action would be performed and therefore there is no potential for environmental impacts during implementation.	Potential adverse environmental impacts related to construction of cover systems include dust generation and uncontrolled stormwater runoff These impacts would be mitigated using standard BMPs for dust control during grading and cover installation and to control stormwater runoff and prevent transport of sediment to streams. Surfaces would be graded and covers would be placed over the exposed overburden surfaces in a timely and efficient manner in order to limit environmental impacts.	Same as Alternative WG-5.
Time Until Remedial Objectives Are Achieved	Currently, selenium concentrations exceed the MCL in Wells Formation groundwater of source areas. Selenium concentrations are expected to reduce over time as the source controls associated with reclamation covers and the Pole Canyon NTCRAs have greater effect.	Protection of human health would be achieved immediately. The reduction in area with selenium concentrations greater than the MCL would be the same as for Alternative WG-1.	Protection of human health would be achieved immediately. Completion of covers on the target areas would result in a reduction of selenium releases from overburden in these areas and would be expected to reduce selenium concentrations in Wells Formation groundwater.	Same as Alternative WG-5.

TABLE 3-1. Detailed Analysis of Remedial Alternatives for Wells Formation Groundwater

	Alternative WG-1 No Further Action	Alternative WG-3 Institutional Controls (ICs)	Alternative WG-5 Capillary Covers, ICs and MNA	Alternative WG-7 Geomembrane Covers, ICs and MNA
Threshold Criteria				
6. Implementability				
Detailed Analysis	***High***	***High***	***Moderate to High***	***Moderate to High***
Ability to Construct and Operate Technology	No construction or O&M would be implemented.	There is no construction for this alternative; however, implementation of ICs would require preparation of an Institutional Controls Implementation and Assurance Plan (ICIAP). The ICIAP would specify how the deed restrictions will be implemented, maintained, enforced, modified, and terminated (if applicable). Deed restrictions would only be applied to areas where selenium concentrations exceed the MCL and would be ultimately be removed when the MCL is met throughout Simplot-owned land in Sage Valley.	Soil covers such as the capillary cover are easily constructed using conventional grading and earthmoving equipment. Difficulties would not be expected during implementation of this alternative. Construction of capillary covers would require Remedial Design (RD), a Remedial Action Work Plan (RAWP), and a Post-Removal Site Control (PRSC) Plan. The RD/RAWP would include grading and cover installation procedures and materials; design of temporary roads, a site restoration plan, stormwater management plan, and a health and safety plan. Periodic O&M and long-term monitoring would be outlined in the PRSC Plan.	Geomembrane covers are constructed using specialized construction techniques but can have constructability issues. Geomembrane covers have been installed at South Maybe Canyon Mine (a CERCLA action on a cross-valley fill). Temperature fluctuations during installation can make welding of seams difficult and can results in wrinkles in the fabric. During cover installation on slopes, instability results from slippage at the interface between the geosynthetic layer and the overlying or underlying material. Geomembrane cover systems can be unstable over long steep slopes which could result in sliding of the liner and the topsoil downslope. For side slopes of 3:1, additional anchoring of the geomembrane is required and angular gravel or rock is required above a geotextile for stability of this layer.
Reliability of the Technology	No technology would be implemented.	Same as Alternative WG-1.	Technical problems leading to schedule delays are not expected during implementation of this alternative.	Technical problems leading to schedule delays are possible during implementation of this alternative due to potential constructability issues.
Ease of Undertaking Additional Remedial Action, if Necessary	No additional actions would be implemented.	ICs do not affect additional remedial actions if deemed necessary.	Future remedial actions at the target areas are not anticipated. Implementation of this alternative would not significantly affect access to Panels D and E, and therefore, would not make implementation of additional remedial actions more difficult.	Additional actions could be difficult to implement. If the geosynthetic layer becomes compromised removal of the overlying soil layer to inspect and repair the liner would be difficult to achieve without potential further damage to the liner.
Ability to Monitor Effectiveness of Remedy	No monitoring would occur.	Same as Alternative WG-1.	The effectiveness of cover systems is easily monitored using standard groundwater monitoring techniques, laboratory analyses and data evaluation processes. Because well locations downgradient of the cover system would be monitored, exposure risks due to remedy component failure would be unlikely.	Same as Alternative WG-5.
Ability to Obtain Approvals and Coordinate with Other Agencies	No approval or coordination necessary.	Same as Alternative WG-1.	Same as Alternative WG-1.	Same as Alternative WG-1.
Availability of Treatment, Storage, and Disposal Services and Capacity	None required.	Same as Alternative WG-1.	Same as Alternative WG-1.	Same as Alternative WG-1.
Availability of Necessary Equipment and Specialists	None required.	ICs would require legal support to prepare the ICIAP and implement. These resources are readily available.	Environmental construction contractors are readily available. Construction of covers would rely on readily available grading and earthmoving equipment.	Same as Alternative WG-5.
Availability/Demonstrated Effectiveness of Prospective Technologies	None required.	Same as Alternative WG-1.	Inclined covers with a capillary barrier effect (CCBE) is an alternative to a conventional soil cover design. The CCBE concept has been developed based on lysimeter observations from the Simple 1 cover at the Blackfoot Bridge Mine. Analysis would be required during remedial design to assess the effectiveness of the components relative to specific material properties and conditions at the Site. Because cover systems constructed of Site materials are widely used, more than one vendor would likely be available to provide a competitive bid.	A geomembrane cover is an available technology that has been constructed as a full-scale cover system at the South Maybe Canyon Mine (a CERCLA action at a cross valley fill). The technology does not require further development before it can be applied to the overburden material at the target areas. Because geosynthetic cover systems are widely used, more than one vendor would likely be available to provide a competitive bid.

TABLE 3-1. Detailed Analysis of Remedial Alternatives for Wells Formation Groundwater

	Alternative WG-1 No Further Action	Alternative WG-3 Institutional Controls (ICs)	Alternative WG-5 Capillary Covers, ICs and MNA	Alternative WG-7 Geomembrane Covers, ICs and MNA
Threshold Criteria				
7. Cost				
Detailed Analysis	***Low***	***Low***	***Moderate***	***High***
30-year Present Worth Total Cost	$0	$936,300	$31,219,300	$70,519,300
Modifying Criteria				
8. State Acceptance	**To be evaluated after the public comment period.**			
9. Community Acceptance	**To be evaluated after the public comment period.**			

Notes:

ARARs - Applicable or Relevant and Appropriate Requirements
BMPs - Best Management Practices
CCBE - Covers with Capillary Barrier Effect
CERCLA - Comprehensive Environmental Response, Compensation and Liability Act
HAZWOPPER - Hazardous Waste Operations and Emergency Response
ICIAP - Institutional Control Implementation and Assurance Plan
ICs - Institutional Controls
MCL - Maximum Contaminant Level
mg/L - milligrams per liter
NTCRA - Non-Time-Critical Removal Action
O&M - Operation and Maintenance
ODA - Overburden Disposal Area
OSHA - Occupational Safety and Health Administration
PPE - Personal Protective Equipment
RAOs - Remedial Action Objectives

TABLE 3-2. Detailed Analysis of Remedial Alternatives for Surface Water

	Alternative SW-1 No Further Action	Alternative SW-3 Capillary Covers	Alternative SW-5 Geomembrane Covers	Alternative SW-6a Treatment of Water Discharging at Hoopes Spring (2,000 gpm)	Alternative SW-6b Treatment of Water Discharging at Hoopes Spring (3,000 gpm)
Threshold Criteria					
1. Protection of Human Health and the Environment					
Detailed Analysis	***Low***	***Moderate to High***	***Moderate to High***	***High***	***High***
Protection of Human Health	There are potential unacceptable future risks to human receptors (recreational camper or Native American) and potential unacceptable current risks to human receptors (Native American) from ingestion of surface water where arsenic concentrations exceed the Idaho drinking water standard in surface water seeps downgradient (east) of Panel D (DS-7) and the Pole Canyon ODA (LP-1), and surface water in detention ponds downgradient of Panel D seep DS-7 (DP-7) and Panel E (EP-2). There are no human health risks related to selenium concentrations in surface water in Sage Creek and Crow Creek.	Human health would be protected through the use of fences and/or signs in the short term and ultimately rock covers to prevent ingestion of surface water in seeps and detention ponds with arsenic concentrations greater than the MCL. There are no human health risks related to selenium concentrations in surface water in Sage Creek and Crow Creek.	Same as Alternative SW-3.	Same as Alternative SW-3.	Same as Alternative SW-3.
Protection of the Environment	Under current conditions, selenium concentrations in surface water in the Sage Creek/Crow Creek watershed downstream of Hoopes Spring are above the surface water quality standards (16.7 µg/L for Sage Creek and 4.2 µg/L for Crow Creek), which represents an unacceptable ecological risk. Selenium concentrations are anticipated to reduce over time as the load from Wells Formation groundwater discharge decreases and could ultimately be in the range of the surface water standard.	Installing capillary covers over the target areas would reduce infiltration of water into overburden in this area and subsequent release of selenium to Wells Formation groundwater. This would reduce the mass flux of selenium discharging with Wells Formation groundwater at the springs complex and consequently the selenium concentrations in surface water in the Sage Creek/Crow Creek watershed downgradient of Hoopes Spring.	Installing geomembrane covers over the target areas would reduce infiltration of water into overburden in this area and subsequent release of selenium to Wells Formation groundwater. This would reduce the mass flux of selenium discharging with Wells Formation groundwater at the springs complex and consequently the selenium concentrations in surface water in the Sage Creek/Crow Creek watershed downgradient of Hoopes Spring.	Water treatment at the Hoopes WTP would immediately reduce selenium in concentrations surface water downstream of Hoopes Spring in the Sage Creek/Crow Creek watershed. Concentrations would still be above the surface water standard in the short-term but are expected to reduce in the future. Concentration reductions would occur more quickly with treatment.	Continued water treatment at the Hoopes WTP would immediately reduce selenium concentrations in surface water downstream of Hoopes Spring in the Sage Creek/Crow Creek watershed. Concentrations would still be above the surface water standard in the short-term but are expected to reduce in the future. Concentration reductions would occur most quickly with this alternative because it contains treatment of a larger flow.
2. Compliance With ARARs					
Detailed Analysis	***Low***	***Moderate to High***	***Moderate to High***	***High***	***High***
Chemical-Specific ARARs	The water quality standard defines the level of protection for fish and therefore the evaluation is the same as for protection of the environment, above.	The water quality standard defines the level of protection for fish and therefore the evaluation is the same as for protection of the environment, above.	The water quality standard defines the level of protection for fish and therefore the evaluation is the same as for protection of the environment, above.	The water quality standard defines the level of protection for fish and therefore the evaluation is the same as for protection of the environment, above.	The water quality standard defines the level of protection for fish and therefore the evaluation is the same as for protection of the environment, above.
Location- and Action-Specific ARARs	Because there is no further action, no location- or action-specific ARARs would be triggered.	Location- and action-specific ARARs would be triggered for reclamation of mined areas and control of fugitive dust during construction of the covers. The requirements would be met by remedial design.	Same as Alternative SW-3.	Location- and action-specific ARARs would be triggered for point source discharges of treated water. The requirements would be met by remedial design.	Location- and action-specific ARARs would be triggered for control of fugitive dust during construction and for point source discharges of treated water. The requirements would be met by remedial design.
Balancing Criteria					
3. Long Term Effectiveness and Permanence					
Detailed Analysis	***Low***	***Moderate to High***	***Moderate to High***	***High***	***High***
Magnitude of Residual Risk	No additional actions would be performed, and therefore, the magnitude of the potential future risks to human receptors (recreational camper or Native American) and potential current risks to human receptors (Native American) from ingestion of arsenic in surface water would not change. Residual risks to ecological receptors from selenium in surface water in the Sage Creek/Crow Creek watershed downstream of Hoopes Spring are predicted to decrease over time. The remaining source of risk is residual contamination in ODAs that is released to seeps, detention ponds, or released to groundwater and ultimately discharged at Hoopes Spring.	Installing capillary covers over the target areas would reduce infiltration of water into overburden in this area and subsequent release of selenium to Wells Formation groundwater. This would reduce the mass flux of selenium discharging with Wells Formation groundwater at the springs complex and consequently the selenium concentrations in surface water in the Sage Creek/Crow Creek watershed downgradient of Hoopes Spring, thereby reducing residual risk. Installation of rock covers on seeps and detention ponds, accompanied by fences and signs, would reduce risks to human receptors immediately upon completion. CERCLA 5-year reviews would be required.	Installing geomembrane covers over the target areas would reduce infiltration of water into overburden in this area and subsequent release of selenium to Wells Formation groundwater. This would reduce the mass flux of selenium discharging with Wells Formation groundwater at the springs complex and consequently the selenium concentrations in surface water in the Sage Creek/Crow Creek watershed downgradient of Hoopes Spring, thereby reducing residual risk. Installation of rock covers on seeps and detention ponds, accompanied by fences and signs, would reduce risks to human receptors immediately upon completion. CERCLA 5-year reviews would be required.	Selenium concentrations in the Sage/Crow Creek watershed downstream from Hoopes Spring and South Fork Sage Creek Springs would be immediately reduced by treatment. The pilot treatment system has removed approximately 40% of the total selenium mass flux emanating from Hoopes Spring and the Springs at South Fork Sage Creek with a corresponding reduction in concentrations in the downstream portions of Sage Creek and Crow Creek. The Hoopes WTP would continue to maintain reduced concentrations over time, which would reduce the magnitude of residual risk. Installation of rock covers on seeps and detention ponds, accompanied by fences and/or signs, would reduce risks to human receptors immediately upon completion. CERCLA 5-year reviews would be required.	Selenium concentrations in the Sage/Crow Creek watershed downstream from Hoopes Spring and South Fork Sage Creek Springs would be immediately reduced by treatment; the existing pilot treatment system has reduced concentrations by 40%. The increase in capacity of the treatment system from 2,000 to 3,000 gpm would result in a reduction in mass flux on the order of 60% for current conditions. The Hoopes WTP would continue to maintain reduced concentrations over time, which would reduce the magnitude of residual risk. Installation of rock covers on seeps and detention ponds, accompanied by fences and/or signs, would reduce risks to human receptors immediately upon completion. CERCLA 5-year reviews would be required.

TABLE 3-2. Detailed Analysis of Remedial Alternatives for Surface Water

	Alternative SW-1 No Further Action	Alternative SW-3 Capillary Covers	Alternative SW-5 Geomembrane Covers	Alternative SW-6a Treatment of Water Discharging at Hoopes Spring (2,000 gpm)	Alternative SW-6b Treatment of Water Discharging at Hoopes Spring (3,000 gpm)
Threshold Criteria					
Adequacy and Reliability of Controls	No controls would be implemented.	Cover construction is straightforward and the covers would be likely to meet performance specifications. Cover systems would require inspections and long-term O&M. The cover would be constructed of natural materials that are viable and long lasting and would not likely need to be replaced. Long-term monitoring surface water monitoring would be required.	Installation of geomembrane covers over the target areas would be an adequate and reliable containment system. Geomembrane covers can be constructed using specialized construction techniques and would be likely to meet performance specifications; however, there can be constructability issues. Geomembrane covers would require inspections and long-term O&M. Because the cover would be constructed of man-made materials that have a finite life expectancy, there is the potential that they would need to be replaced. Long-term surface water monitoring would be required.	Treatment of surface water at the Hoopes WTP would require long-term O&M of the treatment system and monitoring of the influent effluent and ultrafiltration backwash to evaluate the effectiveness of the treatment system. Downstream surface water monitoring may be required. Technical components of the treatment system (e.g., biosolids, mechanical parts, etc.) would likely need to be replaced from time to time. Post-treatment sludge would be disposed in a Subtitle D landfill.	Same as Alternative SW-6a.
4. Reduction of Toxicity, Mobility, or Volume Through Treatment					
Detailed Analysis	***Low***	***Low***	***Low***	***High***	***High***
Treatment Process Used and Materials Treated	None.	None.	None.	The Hoopes treatment system uses ultrafiltration (UF) to remove particulate material and reverse osmosis (RO) and fluidized bed bioreactors (FBRs) to remove selenium and other contaminants from spring water pumped from Hoopes Spring and South Fork Sage Creek Springs. Polishing steps used in the existing treatment system include aeration, clarification, and sand filtration. The WTP also uses an activated sludge post treatment system.	Same as Alternative SW-6a.
Amount of Hazardous Materials Destroyed or Treated	None.	None.	None.	The Hoopes WTP operates at a maximum design flow rate of approximately 2,000 gpm.	The Hoopes WTP would be expanded under Alternative SW-6b to operate at a maximum design flow rate of approximately 3,000 gpm.
Degree of Expected Reductions in Toxicity, Mobility, and Volume	None.	None.	None.	During the initial 20-week performance monitoring period, influent selenium concentrations averaged 0.144 mg/L and effluent concentrations averaged 0.0143 mg/L, which is approximately an order of magnitude reduction in concentration.	Same as Alternative SW-6a.
Degree to Which Treatment is Irreversible	No treatment.	No treatment.	No treatment.	Treatment of surface water by UF/RO FBR is not reversible.	Same as Alternative SW-6a.
Type and Quantity of Treatment Residuals Remaining After Treatment	None.	None.	None.	Sludge generated from the post-treatment system is trucked to a Subtitle D landfill for disposal. The sludge solids are analyzed using TCLP and meet RCRA guidelines to be classified as non-hazardous waste.	Same as Alternative SW-6a.
Statutory Preference for Treatment as a Principal Element	Alternative SW-1 does not satisfy the statutory preference for treatment.	Alternative SW-3 does not satisfy the statutory preference for treatment.	Alternative SW-5 does not satisfy the statutory preference for treatment.	Alternative SW-6a satisfies the statutory preference for treatment.	Alternative SW-6b satisfies the statutory preference for treatment.
5. Short-Term Effectiveness					
Detailed Analysis	***Low***	***Moderate***	***Moderate***	***High***	***High***
Protection of Community During Remedial Actions	No additional remedial actions would be implemented.	There would be no increased risk to local communities during remediation activities because it is anticipated that borrow materials needed to construct the capillary cover are available at or near the mine.	Same as Alternative SW-3.	There would be no increased risk to local communities related to construction and implementation of a remedy for the continued use of the existing Hoopes WTP .	There would be minimal increased risk to local communities related to construction of a third UF/RO FBR treatment system at the Hoopes WTP.
Protection of Workers During Remedial Actions	No additional remedial actions would be implemented.	Risk of construction worker exposure to dust and overburden material during remedial construction activities would be mitigated using standard health and safety protocols and BMPs. Construction associated with the covers would pose low risk to workers, because they are performed with standard construction techniques and have a demonstrated high level of safety when performed with appropriate safety precautions and procedures. Workers would be protected by having OSHA and HAZWOPER training, wearing appropriate PPE and by following established health and safety procedures and protocols. O&M activities are routine and would present a low risk to workers.	Same as Alternative SW-3.	There would be no increased risk to construction workers related to construction of a remedy for the continued use of the existing Hoopes WTP .	Risk of construction worker exposure to dust and seep water during remedial construction activities would be mitigated using standard health and safety protocols and BMPs. Construction associated with the WTP would pose low risk to workers, because they are performed with standard construction techniques and have a demonstrated high level of safety when performed with appropriate safety precautions and procedures. Workers would be protected by having OSHA and HAZWOPER training, wearing appropriate PPE and by following established health and safety procedures and protocols. O&M activities are routine and would present a low risk to workers.
Environmental Impacts Expected with Construction and Implementation of Remedial Actions	No additional remedial actions would be implemented so there are no environmental impacts due to construction.	Potential adverse environmental impacts related to construction of cover systems include dust generation and uncontrolled stormwater runoff. These impacts would be mitigated using standard BMPs for dust control during grading and cover installation and to control stormwater runoff and prevent transport of sediment to streams. Surfaces would be graded and covers would be placed over the exposed overburden surfaces in a timely and efficient manner in order to limit environmental impacts.	Same as Alternative SW-3.	There would be no additional environmental impacts associated with Alternative SW-6a because the treatment system has already been constructed.	Potential adverse environmental impacts related to construction of a third treatment train include dust generation and stormwater runoff. These impacts would be mitigated using standard BMPs for dust control and to prevent transport of sediment to streams.

TABLE 3-2. Detailed Analysis of Remedial Alternatives for Surface Water

	Alternative SW-1 No Further Action	Alternative SW-3 Capillary Covers	Alternative SW-5 Geomembrane Covers	Alternative SW-6a Treatment of Water Discharging at Hoopes Spring (2,000 gpm)	Alternative SW-6b Treatment of Water Discharging at Hoopes Spring (3,000 gpm)
Threshold Criteria					
Time Until Remedial Objectives Are Achieved	RAOs would not be achieved over the short term.	Completion of covers at the target areas would result in a reduction of selenium releases from these ODAs and would be expected to reduce selenium mass flux in Wells Formation groundwater and consequently the mass flux discharging at the springs compare over time.	Same as Alternative SW-3.	Selenium concentrations in the Sage/Crow Creek watershed downstream from Hoopes Spring and South Fork Sage Creek Springs would be immediately reduced by treatment.	Same as Alternative SW-6a.
6. Implementability					
Detailed Analysis	***High***	***Moderate to High***	***Moderate to High***	***High***	***High***
Ability to Construct and Operate Technology	No construction or O&M would be implemented.	Soil covers such as the capillary cover are easily constructed using conventional grading and earthmoving equipment. Difficulties would not be expected during implementation of this alternative. Construction of covers would require Remedial Design (RD), a Remedial Action Work Plan (RAWP), and a Post-Removal Site Control (PRSC) Plan. The RD/RAWP would include grading and cover installation procedures and materials; design of temporary roads, a site restoration plan, stormwater management plan, and a health and safety plan. Periodic O&M and long-term monitoring would be outlined in the PRSC Plan.	Geomembrane covers are constructed using specialized construction techniques but can have constructability issues. Geomembrane covers have been installed at South Maybe Canyon Mine (a CERCLA action on a cross-valley fill). Temperature fluctuations during installation can make welding of seams difficult and can results in wrinkles in the fabric. During cover installation on slopes, instability results from slippage at the interface between the geomembrane layer and the overlying or underlying material. Geomembrane material can be unstable over long steep slopes which could result in sliding of the liner and the topsoil downslope. For side slopes of 3:1, additional anchoring of the geomembrane is required and angular gravel or rock is required above a geotextile for stability of this layer. Installation of rock covers at seeps and detention ponds would be easily implemented.	The existing Hoopes treatment system was constructed as a pilot study in 2014 and treated 200 to 250 gpm of comingled flow from South Fork Sage Creek springs and Hoopes Spring. A second FBR was added in 2017 to increase the treatment capacity to 2,500 gpm. No additional construction is planned as part of this alternative.	The existing Hoopes treatment system was constructed as a pilot study in 2014 and treated 200 to 250 gpm of comingled flow from South Fork Sage Creek springs and Hoopes Spring. A second FBR was added in 2017 to increase the treatment capacity to 2,500 gpm. Construction of a third FBR would be implemented to increase the capacity to 3,000 gpm as part of this alternative.
Reliability of the Technology	No technology would be implemented.	Technical problems leading to schedule delays are not expected during implementation of this alternative.	Technical problems leading to schedule delays are possible during implementation of this alternative due to constructability issues.	Technical problems leading to schedule delays are not expected during implementation of this alternative because the Hoopes treatment system is already up and running.	Technical problems leading to schedule delays are not expected during construction of this alternative but could occur during startup of the additional UF/RO FBR system.
Ease of Undertaking Additional Remedial Action, if Necessary	No additional remedial actions would be implemented.	Implementation of this alternative would not significantly affect access to Panel D or Panel E, and therefore, would not make implementation of additional remedial actions more difficult.	Additional actions could be difficult to implement. If the geosynthetic layer becomes compromised removal of the overlying soil layer to inspect and repair the liner would be difficult to achieve without potential further damage to the liner.	Future remedial actions could include addition of another UF/RO FBR treatment train to increase the capacity of the Hoopes WTP (see Alternative SW-6b).	Alternative SW-6b consists of the addition of another UF/RO FBR treatment train to increase the capacity of the Hoopes WTP. Implementation of a third FBR would require additional land upon which to construct it but would be fairly easy to implement.
Ability to Monitor Effectiveness of Remedy	No monitoring would occur.	The effectiveness of cover systems is easily monitored using standard surface water monitoring techniques, laboratory analyses and data evaluation processes. Because stream locations downstream of the cover system would be monitored, exposure risks due to treatment system failure would be unlikely.	Same as Alternative SW-3.	The effectiveness of the treatment system is easily monitored using standard surface water monitoring techniques, laboratory analyses and data evaluation processes. Because the effluent from the treatment system and stream locations immediately downstream of the Hoopes WTP would be monitored, exposure risks due to treatment system failure would be unlikely.	Same as Alternative SW-6a.
Ability to Obtain Approvals and Coordinate with Other Agencies	No approval or coordination necessary.	Same as Alternative SW-1.	Same as Alternative SW-1.	Same as Alternative SW-1.	Same as Alternative SW-1.
Availability of Treatment, Storage, and Disposal Services and Capacity	None required.	Same as Alternative SW-1.	Same as Alternative SW-1.	Sludge generated from the post-treatment system would be trucked to a Subtitle D landfill for disposal. Because the quantity of sludge that requires disposal is small, the capacity of the landfill would be adequate.	Same as Alternative SW-6a.
Availability of Necessary Equipment and Specialists	None required.	Environmental construction contractors are readily available. Construction of covers would rely on readily available grading and earthmoving equipment.	Same as Alternative SW-3.	Simplot has trained staff and the necessary equipment to operate and maintain the existing Hoopes WTP. Simplot staff also perform routine monitoring of the influent and effluent and the surface water downstream of the treatment system discharge. Existing vendors are available if additional equipment is needed.	Simplot has trained staff and the necessary equipment to operate and maintain the existing Hoopes WTP. Simplot staff also perform routine monitoring of the influent and effluent and the surface water downstream of the treatment system discharge. Existing vendors are available for the equipment for the third treatment train.

TABLE 3-2. Detailed Analysis of Remedial Alternatives for Surface Water

	Alternative SW-1 No Further Action	Alternative SW-3 Capillary Covers	Alternative SW-5 Geomembrane Covers	Alternative SW-6a Treatment of Water Discharging at Hoopes Spring (2,000 gpm)	Alternative SW-6b Treatment of Water Discharging at Hoopes Spring (3,000 gpm)
Threshold Criteria					
Availability/Demonstrated Effectiveness of Prospective Technologies	None required.	Inclined covers with a capillary barrier effect (CCBE) is an alternative to a conventional soil cover design. The CCBE concept has been developed based on lysimeter observations from the Simple 1 cover at the Blackfoot Bridge Mine. Testing would be required during remedial design to assess the effectiveness of the components relative to specific material properties and conditions at the Site. Because cover systems constructed of Site materials are widely used, more than one vendor would likely be available to provide a competitive bid.	A geomembrane cover is an available technology that has been constructed as a full-scale cover system on downstream slopes at the South Maybe Canyon Mine cross valley fill. The technology does not require further development before it can be applied to the overburden material at the target areas. Cover systems proposed under this alternative are full scale. Because geomembrane cover systems are widely used, more than one vendor would likely be available to provide a competitive bid.	The UF/RO FBR technologies used in the existing Hoopes treatment system are readily available and have been proven effective during the Phase 1 and Phase 2 Pilot Studies at Hoopes Spring. The UF/RO system was tested as a mini-pilot before it was brought on for full-scale treatment. Vendors selected for the pilot study would continue to be used as needed for equipment replacement and upgrades during the remedial action.	The UF/RO FBR technologies used in the existing Hoopes treatment system are readily available and have been proven effective during the Phase 1 and Phase 2 Pilot Studies at Hoopes Spring. The UF/RO system was tested as a mini-pilot before it was brought on for full-scale treatment. Vendors selected for the pilot study would continue to be used for new equipment for the third treatment train and for equipment replacement and upgrades.
7. Cost					
Detailed Analysis	***Low***	***Moderate***	***High***	***High***	***High***
30-year Present Worth Total Cost	$0	$31,225,400	$70,525,400	$66,269,800	$109,383,200
Modifying Criteria					
8. State Acceptance	**To be evaluated after the public comment period.**				
9. Community Acceptance	**To be evaluated after the public comment period.**				

Notes:

ARARs - Applicable or Relevant and Appropriate Requirements
BMPs - Best Management Practices
CERCLA - Comprehensive Environmental Response, Compensation and Liability Act
gpm - gallons per minute
HAZWOPER - Hazardous Waste Operations and Emergency Response
mg/L - milligrams per liter
O&M - Operation and Maintenance
ODA - Overburden Disposal Area
OSHA - Occupational Safety and Health Administration
PPE - Personal Protective Equipment
PRSC - Post-Removal Site Control
RAOs - Remedial Action Objectives
RCRA - Resource, Conservation and Recovery Act
TCLP - Toxicity Characteristic Leaching Procedure
UF/RO FBR - Ultrafiltration/Reverse Osmosis Fluidized Bed Bioreactor
WTP - Water Treatment Plant

TABLE 3-3. Detailed Analysis of Remedial Alternatives for Alluvial Groundwater

	Alternative AG-1 No Further Action	Alternative AG-3 Institutional Controls (ICs) and MNA	Alternative AG-5 Permeable Reactive Barrier, ICs and MNA
Threshold Criteria			
1. Protection of Human Health and the Environment			
Detailed Analysis	***Low***	***High***	***High***
Protection of Human Health	Human health would not be protected because the use of alluvial groundwater with selenium concentrations above the MCL as a source of drinking water would not be prevented.	Future residential development and use of alluvial groundwater as a drinking water supply is not a potential land use for Forest Service land. The adjacent area is owned by Simplot and ICs (deed restrictions) would be protective by preventing the use of groundwater with selenium concentrations above the MCL as a source of drinking water. Deed restrictions would only be applied to areas where selenium concentrations exceed the MCL and would be ultimately be removed when the MCL is met throughout Simplot-owned land in Sage Valley.	Same as Alternative AG-3.
Protection of the Environment	There are no ecological risks associated with alluvial groundwater.	Same as Alternative AG-1.	Same as Alternative AG-1.
2. Compliance With ARARs			
Detailed Analysis	***Moderate***	***Moderate to High***	***Moderate to High***
Chemical-Specific ARARs	Under current conditions, selenium concentrations in alluvial groundwater downgradient of the Pole Canyon ODA are above the MCL, and represent exceedances of a chemical-specific ARAR. Chemical-specific ARARs for selenium in alluvial groundwater would not be met immediately, but would be achieved in the longer term due to the NTCRAs, likely with the exception of a small area within Pole Canyon close to the ODA.	Same as Alternative AG-1. Specific performance objectives (e.g., prevent access or use of alluvial groundwater until cleanup levels are met) would be included in the Record of Decision and then specified as restrictions on the property deed.	Reductions of selenium concentrations in alluvial groundwater would be expected within months. Therefore, selenium concentrations would be expected to be reduced to below the MCL at all alluvial groundwater monitoring locations outside of Pole Canyon (i.e., in Sage Valley) within 1 year.
Location- and Action-Specific ARARs	Because there is no further action, no location- or action-specific ARARs would be triggered.	No location- or action-specific ARARs would be triggered by ICs.	Construction of a PRB in Pole Canyon just downgradient of the ODA seep would trigger laws or regulations (location-specific ARARs) intended to protect wetlands, natural streams and waterbodies and those associated with testing and proper disposal of solid waste. This alternative would trigger action-specific ARARs such as laws or regulations intended to protect fish and wildlife. Compliance with these ARARs would be expected to be straightforward and would be addressed during remedial design.
Balancing Criteria			
3. Long Term Effectiveness and Permanence			
Detailed Analysis	***Low***	***Moderate to High***	***Moderate to High***
Magnitude of Residual Risk	Residual risks would remain related to the potential for use of alluvial groundwater as a drinking water source on Simplot-owned land downgradient of the Pole Canyon ODA. Selenium mass flux and concentrations in the alluvial aquifer are expected to decline as the source controls associated with the Pole Canyon NTCRAs have greater effect. The remaining source of risk is residual contamination in the Pole Canyon ODA that is discharged to the LP-1 seep or released to alluvial groundwater.	The potential for use of alluvial groundwater as a drinking water source would be eliminated by ICs. The area of groundwater with selenium concentrations above the MCL would reduce over time as the source controls associated with the Pole Canyon NTCRAs have greater effect. The remaining source of risk is residual contamination in the Pole Canyon ODA that is discharged to the LP-1 seep or released to alluvial groundwater. CERCLA 5-year reviews would be required.	The potential for use of alluvial groundwater as a drinking water source would be eliminated by ICs. The PRB would reduce the extent of alluvial groundwater with selenium concentrations above the MCL. Initial results from a pilot treatability study at the nearby Conda/Woodall Mountain Mine indicate that PRB treatment efficiency in removing selenium is in the range of 95%. The remaining source of risk is residual contamination in the Pole Canyon ODA that percolates downward and is discharged to alluvial groundwater beneath the ODA and is not captured by the PRB. CERCLA 5-year reviews would be required.
Adequacy and Reliability of Controls	No controls would be implemented.	Simplot owns the land and ICs would be adequate to restrict human exposures to alluvial groundwater.	The PRB technology is adequate, reliable, and would require a moderate degree of O&M and long-term monitoring to evaluate and maintain performance. The PRB treatment media will eventually become exhausted and will need to be replaced. If spent treatment materials are removed from the system they would be tested to determine appropriate disposal.

TABLE 3-3. Detailed Analysis of Remedial Alternatives for Alluvial Groundwater

	Alternative AG-1 No Further Action	Alternative AG-3 Institutional Controls (ICs) and MNA	Alternative AG-5 Permeable Reactive Barrier, ICs and MNA
Threshold Criteria			
4. Reduction of Toxicity, Mobility, or Volume Through Treatment			
Detailed Analysis	***Low***	***Low***	***High***
Treatment Process Used and Materials Treated	None.	None.	Selenium in water at the LP-1 seep would be treated in-situ using a PRB that would allow water to passively flow though reactive treatment media installed in a trench positioned immediately downgradient of the seep in Pole Canyon. The media placed in the PRBs would have a permeability appropriate for the hydraulic conductivities of surrounding materials and with adequate retention times. It is likely that the PRB design would be based on the PRB installed and being pilot tested at the Conda Mine.
Amount of Hazardous Materials Destroyed or Treated	None.	None.	PRBs are demonstrated to be effective at removing selenium. The reactive media use chemical and microbial processes to chemically reduce and transform selenium from selenate to selenite and ultimately to elemental selenium.
Degree of Expected Reductions in Toxicity, Mobility, and Volume	None.	None.	Properly designed, constructed and maintained PRB would be expected to reduce selenium concentrations to below the MCL outside of Pole Canyon (i.e., in Sage Valley).
Degree to Which Treatment is Irreversible	No treatment.	No treatment.	PRB treatment is not reversible for the relatively unchanging conditions found in LP-1 seep water. Pilot studies are being performed at Conda Mine to evaluate the treatment performance over time but there are no data to estimate actual performance over time. Expectations are that complete treatment removal will be needed every 10 to 20 years. Selenium could potentially be released from spent treatment media, but this would be evaluated during O&M and the media would be removed if necessary.
Type and Quantity of Treatment Residuals Remaining After Treatment	None.	None.	Once treatment was complete, treatment media could be left in place or removed, depending on its characteristics. If spent treatment materials would be removed from the system they would be tested to determine appropriate disposal.
Statutory Preference for Treatment as a Principal Element	Alternative AG-1 does not satisfy the statutory preference for treatment.	Alternative AG-3 does not satisfy the statutory preference for treatment.	Alternative AG-5 satisfies the statutory preference for treatment.
5. Short-Term Effectiveness			
Detailed Analysis	***Moderate***	***High***	***High***
Protection of Community During Remedial Actions	No additional remedial actions would be implemented.	No physical remedial action would be performed, and therefore, there is no potential for risk to the community during implementation.	The construction effort would be small and the location is distant from any residences. There would be a slightly increased risk to the community due to increased truck traffic on the roads to bring materials to the Site.
Protection of Workers During Remedial Actions	No additional remedial actions would be implemented.	No physical remedial action would be performed, and therefore, there is no potential for risk to workers during implementation.	Construction associated with the PRB would pose low risk to workers, because construction would be performed with standard construction techniques and a demonstrated high level of safety when performed with appropriate safety precautions and procedures. Workers would be protected by having OSHA and HAZWOPER training, wearing appropriate PPE and by following established health and safety procedures and protocols. O&M activities are routine and would present a low risk to workers.
Environmental Impacts Expected with Construction and Implementation of Remedial Actions	No additional remedial actions would be implemented.	No physical remedial action would be performed, and therefore, there is no potential for environmental impacts during implementation.	Potential environmental impacts associated with the construction and operation of a PRB would be minimal. The PRB would be constructed in a relatively narrow canyon. Dust generation and stormwater runoff would be mitigated using standard BMPs for erosion and dust control during excavation of the trench to prevent transport of sediment to Pole Canyon Creek. Any potential alterations to groundwater flow (for example if the PRB became fouled) would be minor. Proper PRB O&M would address any potential issues.
Time Until Remedial Objectives Are Achieved	Currently, selenium concentrations exceed the MCL in alluvial groundwater in Pole Canyon, downgradient of the ODA, and in a relatively small area of Sage Valley. The rate of release of selenium from the Pole Canyon ODA will continue to decrease over time, and as indicated by the monitoring data selenium mass flux and concentrations in the alluvial aquifer are also expected to decline.	Protection of human health would be achieved immediately. The reduction in area with selenium concentrations greater than the MCL would be the same as for Alternative AG-1.	The PRB would treat Pole Canyon ODA seep water as it passes through the permeable reactive treatment materials and would reduce selenium concentrations immediately downgradient of the PRB relatively quickly. Reductions of selenium concentrations in alluvial groundwater would be expected within months. Therefore, selenium concentrations would be expected to be reduced to below the MCL at all alluvial groundwater monitoring locations in Sage Valley within 1 year.

TABLE 3-3. Detailed Analysis of Remedial Alternatives for Alluvial Groundwater

	Alternative AG-1 **No Further Action**	**Alternative AG-3** **Institutional Controls (ICs) and MNA**	**Alternative AG-5** **Permeable Reactive Barrier, ICs and MNA**
Threshold Criteria			
6. Implementability			
Detailed Analysis	***High***	***High***	***High***
Ability to Construct and Operate Technology	No construction or O&M would be implemented.	There is no construction for this alternative; however, implementation of ICs would require preparation of an Institutional Controls Implementation and Assurance Plan (ICIAP). The ICIAP would specify how the deed restrictions will be implemented, maintained, enforced, modified, and terminated (if applicable). Deed restrictions would only be applied to areas where selenium concentrations exceed the MCL and would be ultimately be removed when the MCL is met throughout Simplot-owned land in Sage Valley.	Construction of the PRB would be conducted using readily available excavation and/or trenching equipment and readily available treatment media. PRB O&M is routine (e.g. water quality monitoring and water level measurements). Installation of a PRB would require Remedial Design (RD), a Remedial Action Work Plan (RAWP), and a Post-Removal Site Control (PRSC) Plan. The RD/RAWP would include PRB installation procedures , depths, and materials; design of temporary roads, a site restoration plan, stormwater management plan, and a health and safety plan. Periodic O&M and long-term monitoring would be outlined in the PRSC Plan.
Reliability of the Technology	No technology would be implemented.	Same as Alternative AG-1.	PRB treatment is a USEPA-recognized remedial alternative for groundwater. The PRB technology is being pilot tested at Simplot's Conda Mine and has been demonstrated to be reliable and effective at P4's South Rasmussen Mine.
Ease of Undertaking Additional Remedial Action, if Necessary	No additional remedial actions would be implemented.	ICs do not affect additional remedial actions if deemed necessary.	Future remedial actions are not likely to be implemented in Pole Canyon. Two NTCRAs have already been completed at the Pole Canyon ODA, and the PRB would be constructed immediately downstream of the Pole Canyon ODA. The PRB would be beneath the ground surface and would not affect the implementation of any additional remedial actions.
Ability to Monitor Effectiveness of Remedy	No monitoring would occur.	Same as Alternative AG-1.	The effectiveness of PRBs is easily monitored using standard groundwater monitoring techniques, laboratory analyses and data evaluation processes. Because well locations immediately downgradient of the PRB would be monitored, exposure risks due to treatment system failure would be unlikely.
Ability to Obtain Approvals and Coordinate with Other Agencies	No approval or coordination necessary.	Same as Alternative AG-1.	Same as Alternative AG-1.
Availability of Treatment, Storage, and Disposal Services and Capacity	None required.	Same as Alternative AG-1.	If spent treatment materials would need to be removed from the system they would be tested to determine appropriate disposal. There are Subtitle C and Subtitle D landfills in Idaho where material could be disposed.
Availability of Necessary Equipment and Specialists	None required.	ICs would require legal support to prepare and implement. These resources are readily available.	PRB construction would require skilled workers, construction equipment and treatment media. PRB operation would require field technicians to perform periodic O&M activities and collect environmental data, and environmental scientists to evaluate performance. These resources are readily available.
Availability/Demonstrated Effectiveness of Prospective Technologies	None required.	Same as Alternative AG-1.	PRBs are demonstrated to be effective at removing selenium. The PRB installed at the Conda Mine uses well graded sand, alfalfa hay and wood chips to promote microbial processes for selenium reduction.
7. Cost			
Detailed Analysis	***Low***	***Low***	***High***
30-year Present Worth Total Cost	$0	$446,900	$1,962,800
Modifying Criteria			
8. State Acceptance	**To be evaluated after the public comment period.**		
9. Community Acceptance	**To be evaluated after the public comment period.**		

Notes:

ARARs - Applicable or Relevant and Appropriate Requirements
HAZWOPPER - Hazardous Waste Operations and Emergency Response
ICs - Institutional Controls
MCL - Maximum Contaminant Level
NTCRA - Non-Time-Critical Removal Action
O&M - Operation and Maintenance
ODA - Overburden Disposal Area
OSHA - Occupational Safety and Health Administration
PPE - Personal Protective Equipment
PRB - Permeable Reactive Barrier
PRSC - Post Removal Site Control
RAWP - Removal Action Work Plan
RD - Remedial Design
USEPA - US Environmental Protection Agency

TABLE 3-4. Detailed Analysis of Remedial Alternatives for Solids and Soil

	Alternative S-1 No Further Action	Alternative S-2 Rock Covers on Soils in Seep and Riparian Areas	Alternative S-3 2-Foot Dinwoody or Salt Lake Formation Covers on Uncovered Areas of ODAs and Rock Covers on Soils in Seep and Riparian Areas
Threshold Criteria			
1. Protection of Human Health and the Environment			
Detailed Analysis	***Low***	***Moderate***	***High***
Protection of Human Health	The PRG for arsenic in soil is met under current conditions; therefore, there are no risks to seasonal ranchers from exposure to arsenic due to ingestion of beef from cattle grazed at the Site.	Same as Alternative S-1.	Same as Alternative S-1.
Protection of the Environment	Under current conditions, there is high confidence of a low likelihood of effects on the abundance/density for small mammals and bird populations are not likely to be adversely affected due to exposure to selenium at the Site.	Covering soils in overburden seep and riparian areas and detention ponds below ODAs with chert/limestone would prevent access to soil with elevated selenium concentrations but would provide minimal additional protection for small mammal and bird populations on uncovered ODAs as compared to Alternative S-1.	Covering all uncovered areas of Panels A and D with Dinwoody or Salt Lake Formation material and soils in seep or riparian areas with chert/limestone would reduce selenium concentrations at the surface of ODAs and would prevent access to soil in those areas but would provide minimal additional protection for small mammal and bird populations as compared to Alternative S-1.
2. Compliance With ARARs			
Detailed Analysis	***Low***	***Moderate***	***High***
Chemical-Specific ARARs	There are no chemical-specific ARARs for soil.	Same as Alternative S-1.	Same as Alternative S-1.
Location- and Action-Specific ARARs	Because there is no further action, no location- or action-specific ARARs would be triggered.	Location- and action-specific ARARs would be triggered for reclamation of mined areas and control of fugitive dust during placement of rock covers. The requirements would be met by remedial design.	Location- and action-specific ARARs would be triggered for reclamation of mined areas and control of fugitive dust during construction of the covers. The requirements would be met by remedial design.
Balancing Criteria			
3. Long Term Effectiveness and Permanence			
Detailed Analysis	***Low***	***Moderate***	***High***
Magnitude of Residual Risk	The Site has approximately 1,060 acres of covered overburden, either by post-mining reclamation (Panels C and E, areas of Panel A and D, and areas at Panel B where mining has been completed) or by NTCRA (Pole Canyon ODA). This provides protection of human health and the environment under current conditions. CERCLA 5-year reviews would be required because "waste" or overburden material would remain in place.	Covering soil in seep and riparian areas and detention ponds with rock covers would prevent access to selenium concentrations at the surface but would provide minimal additional protection for small mammal and bird populations on uncovered ODAs as compared to Alternative S-1. CERCLA 5-year reviews would be required.	Covering the uncovered areas of Panels A and D with Dinwoody or Salt Lake Formation material and soils in seep and riparian areas with chert/limestone would reduce the selenium concentrations at the surface but would provide minimal additional protection for small mammal and bird populations as compared to Alternative S-1. CERCLA 5-year reviews would be required.
Adequacy and Reliability of Controls	No controls would be implemented.	Construction of rock covers is straightforward and the covers would be likely to meet performance specifications and would not need to be replaced.	Cover construction is straightforward and the covers would be likely to meet performance specifications. Dinwoody or Salt Lake Formation covers would require inspections and long-term O&M. The cover would be constructed of natural materials that would be viable and long lasting and would not likely need to be replaced.

TABLE 3-4. Detailed Analysis of Remedial Alternatives for Solids and Soil

	Alternative S-1 No Further Action	Alternative S-2 Rock Covers on Soils in Seep and Riparian Areas	Alternative S-3 2-Foot Dinwoody or Salt Lake Formation Covers on Uncovered Areas of ODAs and Rock Covers on Soils in Seep and Riparian Areas
Threshold Criteria			
4. Reduction of Toxicity, Mobility, or Volume Through Treatment			
Detailed Analysis	***Low***	***Low***	***Low***
Treatment Process Used and Materials Treated	None.	None.	None.
Amount of Hazardous Materials Destroyed or Treated	None.	None.	None.
Degree of Expected Reductions in Toxicity, Mobility, and Volume	None.	None.	None.
Degree to Which Treatment is Irreversible	No treatment.	No treatment.	No treatment.
Type and Quantity of Treatment Residuals Remaining After Treatment	None.	None.	None.
Statutory Preference for Treatment as a Principal Element	Alternative S-1 does not satisfy the statutory preference for treatment.	Alternative S-2 does not satisfy the statutory preference for treatment.	Alternative S-3 does not satisfy the statutory preference for treatment.
5. Short-Term Effectiveness			
Detailed Analysis	***Low***	***Moderate***	***Moderate to High***
Protection of Community During Remedial Actions	No additional actions would be implemented.	There would be no increased risk to local communities during remediation activities because chert/limestone materials needed to construct the rock covers are available at the mine.	There would be no increased risk to local communities during remediation activities because borrow materials needed to construct the Dinwoody or Salt Lake Formation cover and chert/limestone needed for the rock covers are available at or near the mine.
Protection of Workers During Remedial Actions	No additional actions would be implemented.	Risk of construction worker exposure to dust and overburden material during remedial construction activities would be mitigated using standard health and safety protocols and BMPs. Construction associated with the covers would pose low risk to workers, because they are performed with standard construction techniques and have a demonstrated high level of safety when performed with appropriate safety precautions and procedures. Workers would be protected by having OSHA and HAZWOPER training, wearing appropriate PPE and following established health and safety procedures and protocols. O&M activities are routine and would present a low risk to workers.	Same as Alternative S-2.
Environmental Impacts Expected with Construction and Implementation of Remedial Actions	No additional actions would be implemented so there are no environmental impacts due to construction.	Potential adverse environmental impacts related to construction of rock covers are limited to dust generation, and would be mitigated using standard BMPs for dust control during.	Potential adverse environmental impacts related to construction and implementation of Dinwoody or Salt Lake Formation covers include dust generation and uncontrolled stormwater runoff. These impacts would be mitigated using standard BMPs for dust control during grading and cover installation and to control stormwater runoff and prevent transport of sediment to streams. Surfaces would be graded and covers would be placed over the exposed overburden surfaces in a timely and efficient manner in order to limit environmental impacts.
Time Until Remedial Objectives Are Achieved	RAOs would not be achieved.	The RAO to reduce or eliminate unacceptable risks to deer mice and birds due to exposure to selenium in soil in overburden seep and riparian areas and detention ponds below ODAs would be achieved immediately after placement of rock covers. Other RAOs would not be achieved.	RAOs would be achieved immediately due to short-term ICs (grazing controls and land-use controls) to restrict access to cover areas while the cover vegetation matures . Dinwoody or Salt Lake Formation covers on the uncovered areas of Panels A and D would reduce or eliminate exposure of deer mice and birds to selenium in soil.

TABLE 3-4. Detailed Analysis of Remedial Alternatives for Solids and Soil

	Alternative S-1 No Further Action	Alternative S-2 Rock Covers on Soils in Seep and Riparian Areas	Alternative S-3 2-Foot Dinwoody or Salt Lake Formation Covers on Uncovered Areas of ODAs and Rock Covers on Soils in Seep and Riparian Areas
Threshold Criteria			
6. Implementability			
Detailed Analysis	***High***	***High***	***Moderate to High***
Ability to Construct and Operate Technology	No construction or O&M would be implemented.	Rock covers are easily constructed using conventional rock moving equipment. Difficulties would not be expected during implementation of this alternative.	Dinwoody or Salt Lake Formation covers are easily constructed using conventional earthmoving equipment. Difficulties would not be expected during implementation of this alternative. Construction of Dinwoody or Salt Lake Formation covers would require Remedial Design (RD), a Remedial Action Work Plan (RAWP), and a Post-Removal Site Control (PRSC) Plan. The RD/RAWP would include grading and cover installation procedures and materials; design of temporary roads, a site restoration plan, stormwater management plan, and a health and safety plan. Periodic O&M and long-term monitoring would be outlined in the PRSC Plan.
Reliability of the Technology	No technology would be implemented.	Properly designed and constructed rock cover systems are demonstrated to be reliable long term.	Properly designed and maintained cover systems are demonstrated to be reliable long term.
Ease of Undertaking Additional Remedial Action, if Necessary	No additional actions would be implemented.	Implementation of rock covers would not affect access to other areas of the Site, and therefore, would not make implementation of additional future actions more difficult.	Future remedial actions at Panels A and D are not anticipated. Construction of Dinwoody or Salt Lake Formation covers would not significantly affect access to Panels A and D, and therefore, would not make implementation of additional actions more difficult.
Ability to Monitor Effectiveness of Remedy	No monitoring would occur.	Same as Alternative S-1.	Inspections and O&M would be used to evaluate the effectiveness of the cover systems.
Ability to Obtain Approvals and Coordinate with Other Agencies	No approval or coordination necessary.	Same as Alternative S-1.	Same as Alternative S-1.
Availability of Treatment, Storage, and Disposal Services and Capacity	None required.	Same as Alternative S-1.	Same as Alternative S-1.
Availability of Necessary Equipment and Specialists	None required.	Environmental construction contractors are readily available. Remedy construction would rely on readily available rock moving equipment.	Environmental construction contractors are readily available. Remedy construction would rely on readily available grading and earthmoving equipment.
Availability/Demonstrated Effectiveness of Prospective Technologies	None required.	Rock covers are a readily available technology that have been implemented successfully at Smoky Canyon Mine. The technology does not require further development before it can be applied to soils in seep and riparian areas and in detention ponds below ODAs.	A Dinwoody or Salt Lake Formation cover is a readily available technology that has been implemented successfully at the Smoky Canyon Mine. The technology does not require further development before it can be applied to the remaining uncovered overburden materials at Panels A and D. Cover systems proposed under this alternative are full scale. Because this type of cover is widely used, more than one vendor would likely be available to provide a competitive bid. Rock covers are also a readily available technology.

TABLE 3-4. Detailed Analysis of Remedial Alternatives for Solids and Soil

	Alternative S-1 No Further Action	Alternative S-2 Rock Covers on Soils in Seep and Riparian Areas	Alternative S-3 2-Foot Dinwoody or Salt Lake Formation Covers on Uncovered Areas of ODAs and Rock Covers on Soils in Seep and Riparian Areas
Threshold Criteria			
7. Cost			
Detailed Analysis	***Low***	***Moderate***	***High***
30-year Present Worth Total Cost	$0	$255,600	$19,633,700
Modifying Criteria			
8. State Acceptance	**To be evaluated after the public comment period.**		
9. Community Acceptance	**To be evaluated after the public comment period.**		

Notes:

ARARs - Applicable or Relevant and Appropriate Requirements
BMPs - Best Management Practices
HAZWOPPER - Hazardous Waste Operations and Emergency Response
MCL - Maximum Contaminant Level
NTCRA - Non-Time-Critical Removal Action
O&M - Operation and Maintenance
ODA - Overburden Disposal Area
OSHA - Occupational Safety and Health Administration
PRG - Preliminary Remediation Goal
RAO - Remedial Action Objectives

TABLE 3-5. Estimated Selenium Loads from the Pole Canyon ODA to Wells Formation Groundwater

Year	Migration from Creek Through ODA (lbs/day)	Migration from Infiltration Through ODA (lbs/day)	Migration from LP-1 (lbs/day)	Total (lbs/day)
2003	1.15	0.36	0.33	1.84
2004	1.30	0.36	0.37	2.03
2005	1.50	0.38	0.43	2.30
2006	1.60	0.47	0.46	2.53
2007	1.60	0.30	0.46	2.36
Average	**1.43**	**0.37**	**0.41**	**2.21**
2008	0	0.37	0.02	0.39
2009	0	0.43	0.03	0.46
2010	0	0.26	0.04	0.30
2011	0.78	0.47	0.38	1.63
2012	0	0.24	0.07	0.31
2013	0	0.25	0.05	0.31
2014	0	0.28	0.19	0.46
2015	0	0.24	0.12	0.36
Average	**0.00**	**0.30**	**0.07**	**0.37**
2016	0	0.18	0.03	0.21
2017	0	0.32	0.10	0.43
2018	0	0.18	0.04	0.22
2019	0	0.17	0.03	0.20
Average	**0**	**0.21**	**0.05**	**0.26**

Notes: lbs/day - pounds per day

TABLE 3-6. Surface Soil Selenium Concentration Statistics and Small Mammal Populations Hazard Quotients - Alternative S-1

Disturbance Area		Number of Samples	Avg	95UCL	Calculated HQ for Small Mammal Populations (95 UCL Conc.)	Area Multiplier	Area-Weighted Statistic Based on Avg	Area-Weighted Statistic Based on 95UCL
Panel	Area (ac)							
Panel A	283	29	7.19	11.41	5.8	0.235	1.69	2.69
Panel B	129	12	1.27	1.611	1.4	0.107	0.14	0.17
Panel C	70	30	3.78	4.175	2.8	0.058	0.22	0.24
Panel D	251	20	10.53	16.26	7.6	0.209	2.20	3.40
Panel E	356	32	1.08	1.504	1.4	0.296	0.32	0.45
Pole ODA [1]	113	3	0.23	0.23	<1	0.094	0.02	0.02
Total Area (ac):	1202	126	4.6	6.8	3.9	**Sitewide:**	4.59	6.96

Notes:

1 - Soil concentrations are from samples collected in the Dinwoody Borrow west of D-panel (material used for the Pole Canyon NTCRA cover).

95UCL = 95th upper confidence limit on the mean

ac = acre

mg/kg = milligram per kilogram

Refer to Table C-1 and Figure C-1 for sampling locations included in the 95UCLs.

95UCLs were calculated using USEPA ProUCL software, version 5.1.002. First recommended value by ProUCL is provided, along with the 95UCL estimation method.

Geometric mean NOAEL TRVs used for HQ calculations.

The deer mouse receptor was used for HQ calculations.

TABLE 3-7. Surface Soil Selenium Concentration Statistics and Bird Populations Hazard Quotients - Alternative S-1

Disturbance Area		Number of Samples	Avg	95UCL	Calculated HQ for Bird Populations (95 UCL Conc.)	Area Multiplier	Area-Weighted Statistic Based on Avg	Area-Weighted Statistic Based on 95UCL
Panel	Area (ac)							
Panel A	283	29	7.19	11.41	4.3	0.235	1.69	2.69
Panel B	129	12	1.27	1.611	1.1	0.107	0.14	0.17
Panel C	70	30	3.78	4.175	2.1	0.058	0.22	0.24
Panel D	251	20	10.53	16.26	5.6	0.209	2.20	3.40
Panel E	356	32	1.08	1.504	1	0.296	0.32	0.45
Pole ODA [1]	113	3	0.23	0.23	<1	0.094	0.02	0.02
Total Area (ac):	1202	126	4.6	6.8	2.9	**Sitewide:**	4.59	6.96

Notes:

1 - Soil concentrations are from samples collected in the Dinwoody Borrow west of D-panel (material used for the Pole Canyon NTCRA cover).

95UCL = 95th upper confidence limit on the mean

ac = acre

mg/kg = milligram per kilogram

Refer to Table C-1 and Figure C-1 for sampling locations included in the 95UCLs.

95UCLs were calculated using USEPA ProUCL software, version 5.1.002. First recommended value by ProUCL is provided, along with the 95UCL estimation method.

Geometric mean NOAEL TRVs used for HQ calculations.

The American robin receptor was used for HQ calculations.

TABLE 3-8. Surface Soil Arsenic Concentration Statistics - Alternative S-1

Disturbance Area		Number of Samples	Avg	95UCL	95UCL Estimation Method	Area Multiplier	Area-Weighted Statistic Based on Avg	Area-Weighted Statistic Based on 95UCL
Panel	**Area (ac)**							
Panel A	283	18	11.19	14.97	95% Adjusted Gamma UCL	0.235	2.6	3.5
Panel B [1]	129	1	7.6	7.6	Set to Pole ODA value	0.107	0.8	0.8
Panel C [1]	70	1	7.6	7.6	Set to Pole ODA value	0.058	0.4	0.4
Panel D	251	20	11.58	13.61	95% Student's-t UCL	0.209	2.4	2.8
Panel E	356	20	5.29	6.157	95% Student's-t UCL	0.296	1.6	1.8
Pole ODA [1]	113	1	7.6	7.6	Fewer than 4 detected values; used available value	0.094	0.7	0.7
Total Area (ac):	1202	61	9.26	10.54	95% H-UCL*	**Sitewide:**	8.59	10.16

Notes:

1 - Soil concentration is from a sample collected in the Dinwoody Borrow west of D-panel (material used for the Pole Canyon NTCRA cover). In this analysis, this arsenic concentration was also used for Panels B and C which have topsoil at the surface.

95UCL = 95th upper confidence limit on the mean

ac = acre

mg/kg = milligram per kilogram

min = minimum; max = maximum; avg = average

ND = non-detected

Refer to Table C-1 and Figure C-1 for sampling locations included in the 95UCLs.

95UCLs were calculated using USEPA ProUCL software, version 5.1.002. First recommended value by ProUCL is provided, along with the 95UCL estimation method.

* The following message was provided by ProUCL: H-statistic often results in unstable values of UCL95. Use of nonparametric methods are preferred to compute UCL95. The non-parametric 95UCL for this dataset is 12.37 mg/kg (method 95% Chebyshev UCL).

TABLE 3-9. Estimated Surface Soil Selenium Concentration Statistics and Small Mammal Populations Hazard Quotients - Alternative S-3

Disturbance Area		Number of Samples	Avg	95UCL	Calculated HQ for Small Mammal Populations	Area Multiplier	Area-Weighted Statistic Based on Avg	Area-Weighted Statistic Based on 95UCL
Panel	Area (ac)							
Panel A	283	29	7.19	1.504	1.4	0.235	1.69	0.35
Panel B	129	12	1.27	1.611	1.4	0.107	0.14	0.17
Panel C	70	30	3.78	4.175	2.8	0.058	0.22	0.24
Panel D	251	20	10.53	1.504	1.4	0.209	2.20	0.31
Panel E	356	32	1.08	1.504	1.4	0.296	0.32	0.45
Pole ODA [1]	113	3	0.23	0.23	<1	0.094	0.02	0.02
Total Area (ac):	1202	126	4.6	6.8		**Sitewide:**	4.59	1.55

Notes:

1 - Soil concentrations are from samples collected in the Dinwoody Borrow west of D-panel (material used for the Pole Canyon NTCRA cover).

95UCL = 95th upper confidence limit on the mean

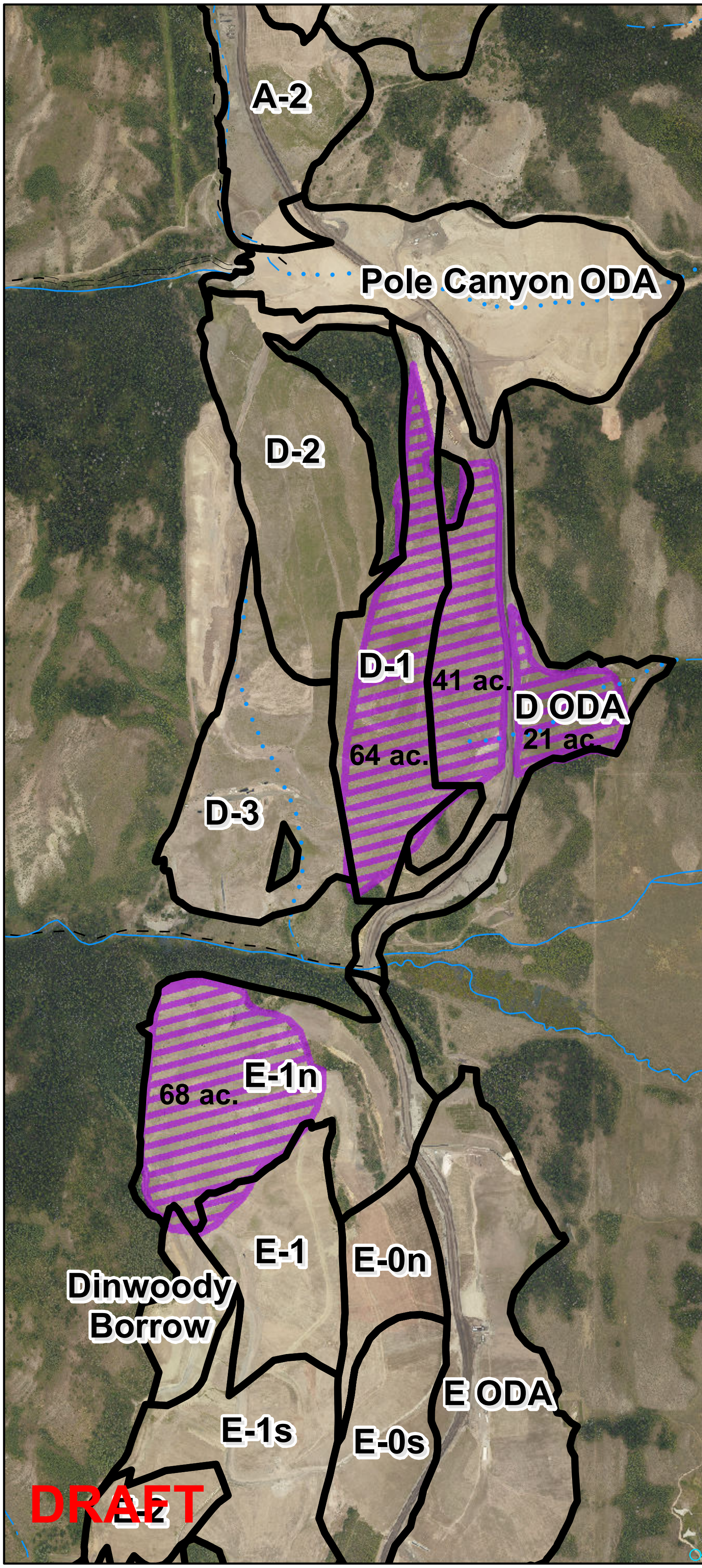
ac = acre

mg/kg = milligram per kilogram

Refer to Table C-1 and Figure C-1 for sampling locations included in the 95UCLs.

95UCLs were calculated using USEPA ProUCL software, version 5.1.002. First recommended value by ProUCL is provided, along with the 95UCL estimation method.

FIGURES



Legend

Mine Pit

Reclamation Cover Area (FS-2)

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE RI/FS
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

FIGURE 2-1

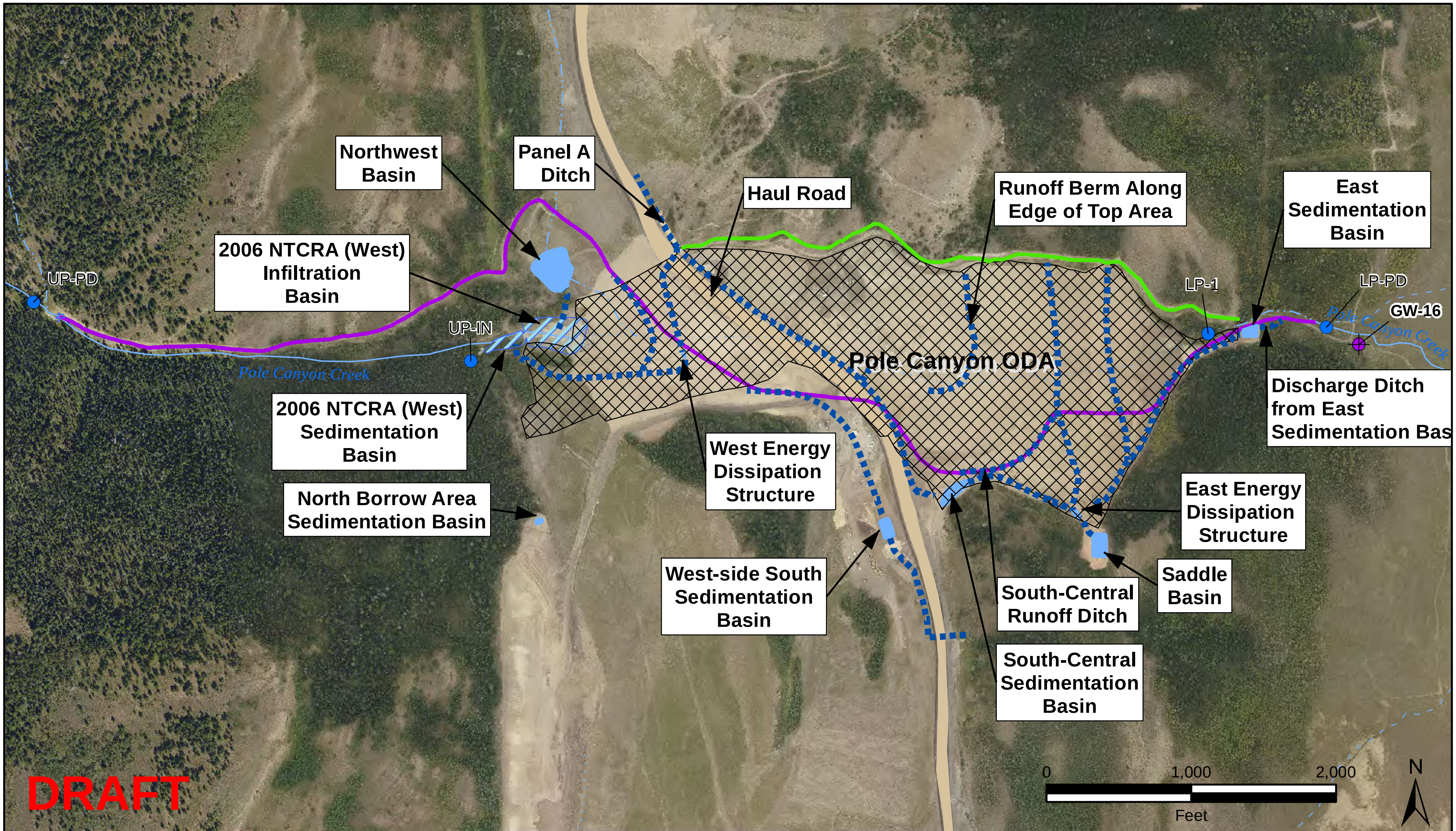
TARGET COVER AREAS OF PANELS D AND E FOR FS COVERS

DATE: APR 01, 2020

BY: CRL | FOR: ACK

FORMATION ENVIRONMENTAL

S:\GIS\arcprj2\010109\plt\FS\TechMemo2\Section2\Fig2-01_Uncovered_DE_FS.mxd



Legend

Surface Water Monitoring Locations	Intermittent Stream
Wells Formation Monitoring Wells	Perennial Stream
Pre-ODA Creek Flow Path	2006 NTCRA Bypass Pipeline Alignment
Irrigation Ditch	Run-on Control Channel
Haul Road	2013 NTCRA Basin Footprints
2006 NTCRA Basin Footprints	

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE RI/FS
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

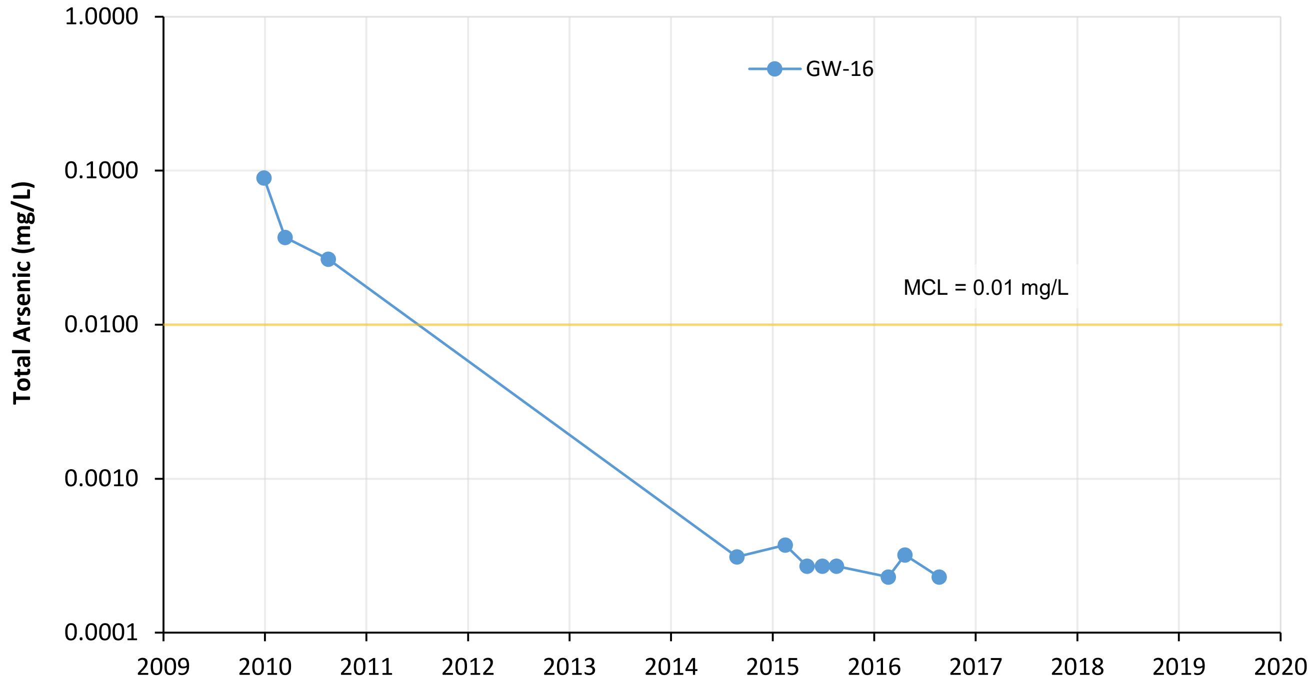
FIGURE 2-2

WELLS FORMATION MONITORING LOCATIONS IN POLE CANYON

DATE: APR 02, 2020
BY: CRL
FOR: ACK

FORMATION ENVIRONMENTAL

S:\GIS\arcprj2\010109\pltIFS\TechMemo2\Section2\Fig2-02_PoleWellsFmGW.mxd



Notes:
1. mg/L = milligrams per liter.
2. MCL = Maximum contaminant level

DRAFT

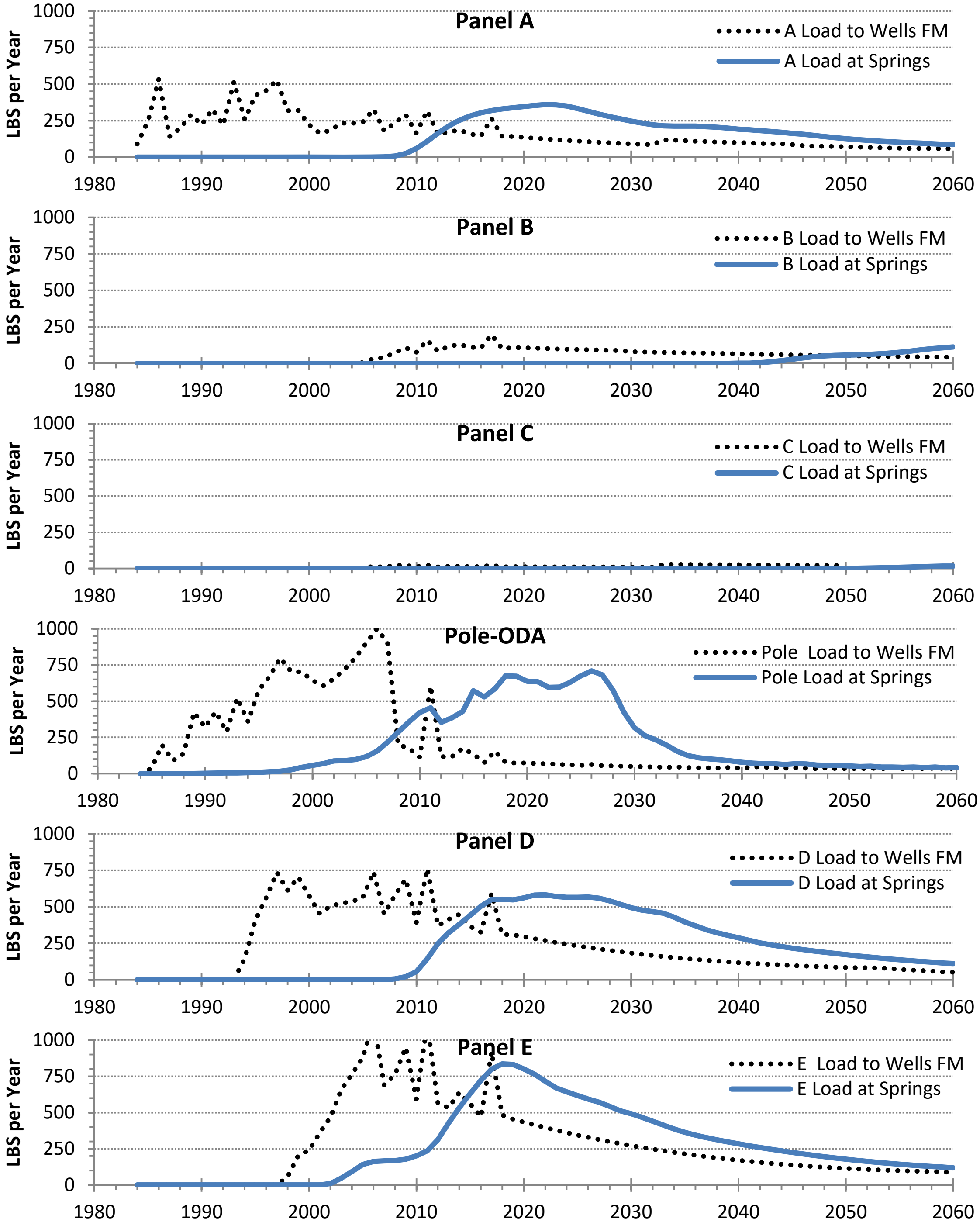
J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

FIGURE 2-3
ARSENIC CONCENTRATIONS IN WELLS FORMATION GROUNDWATER AT THE MOUTH OF POLE CANYON (GW-16)

DATE: APRIL 2020
BY: WSB
FOR: ACK

FORMATION ENVIRONMENTAL

"S:\Jobs\Smoky\CERCLA\FS\FSTM2\Support\ArsenicTimeSeriesGW_20190918.xlsx"



Notes:
1. LBS = Pounds
2. Estimated loads from Groundwater Model (See Appendix A)

DRAFT

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

FIGURE 2-4

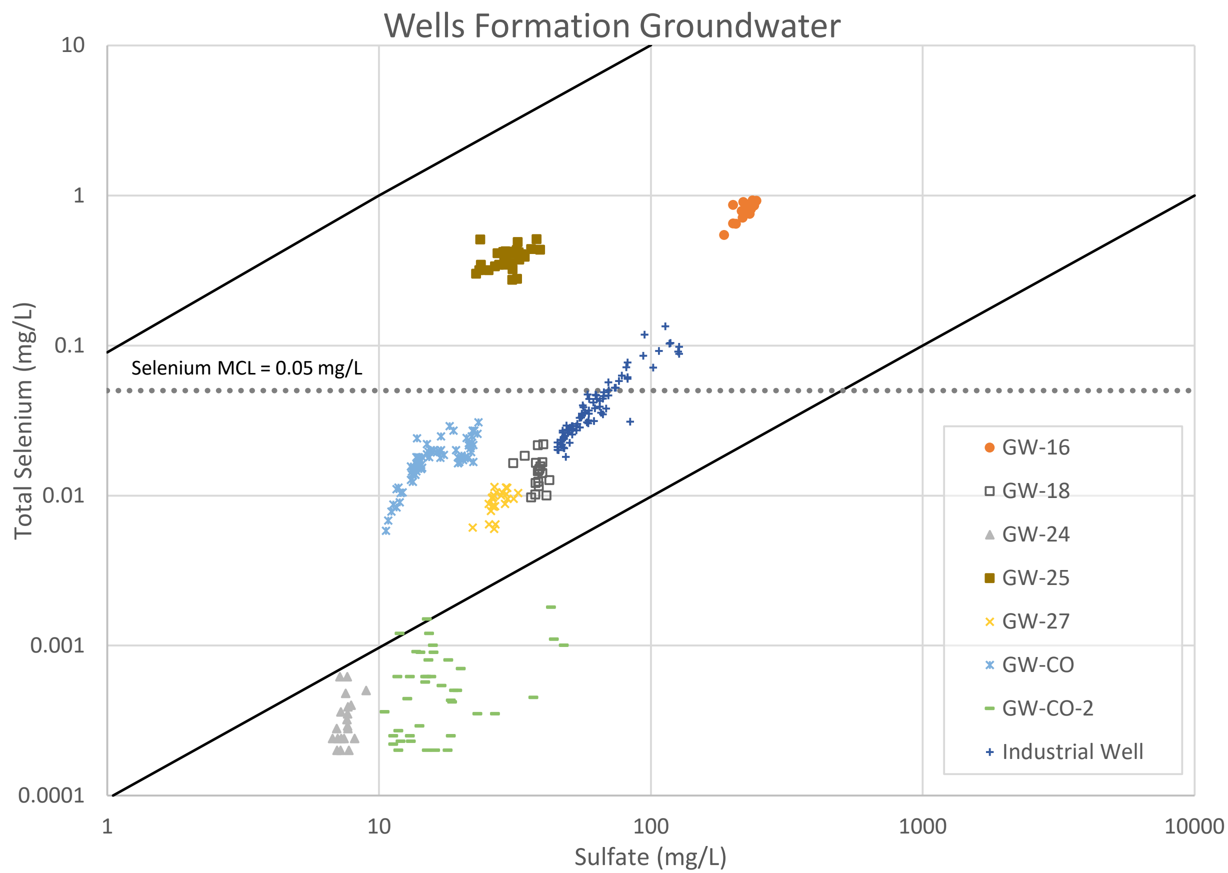
ESTIMATED SELENIUM MASS LOAD TO THE WELLS FORMATION AND ARRIVAL AT SPRING COMPLEX FOR EACH SOURCE AREA

DATE: APRIL 2020
BY: PHT | FOR: ACK

FORMATION ENVIRONMENTAL

S:\Jobs\Smoky\CERCLA\FS\Model\GW_rev2019\FS_Model_revB16in_BASE.xlsx

"S:\JOBS\SMOKY\CERCLA\FS\FSTM2\FIGURES\APRILDRAFT\SECTION2\FIG2-05_SE_VS_SO4WELLSGW.PPTX"



Notes:

1. mg/L = milligrams per liter.
2. Data shown in plot is from 2012 to present.
3. Total selenium and sulfate data is provided in Table 2-6.

DRAFT

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

FIGURE 2-5

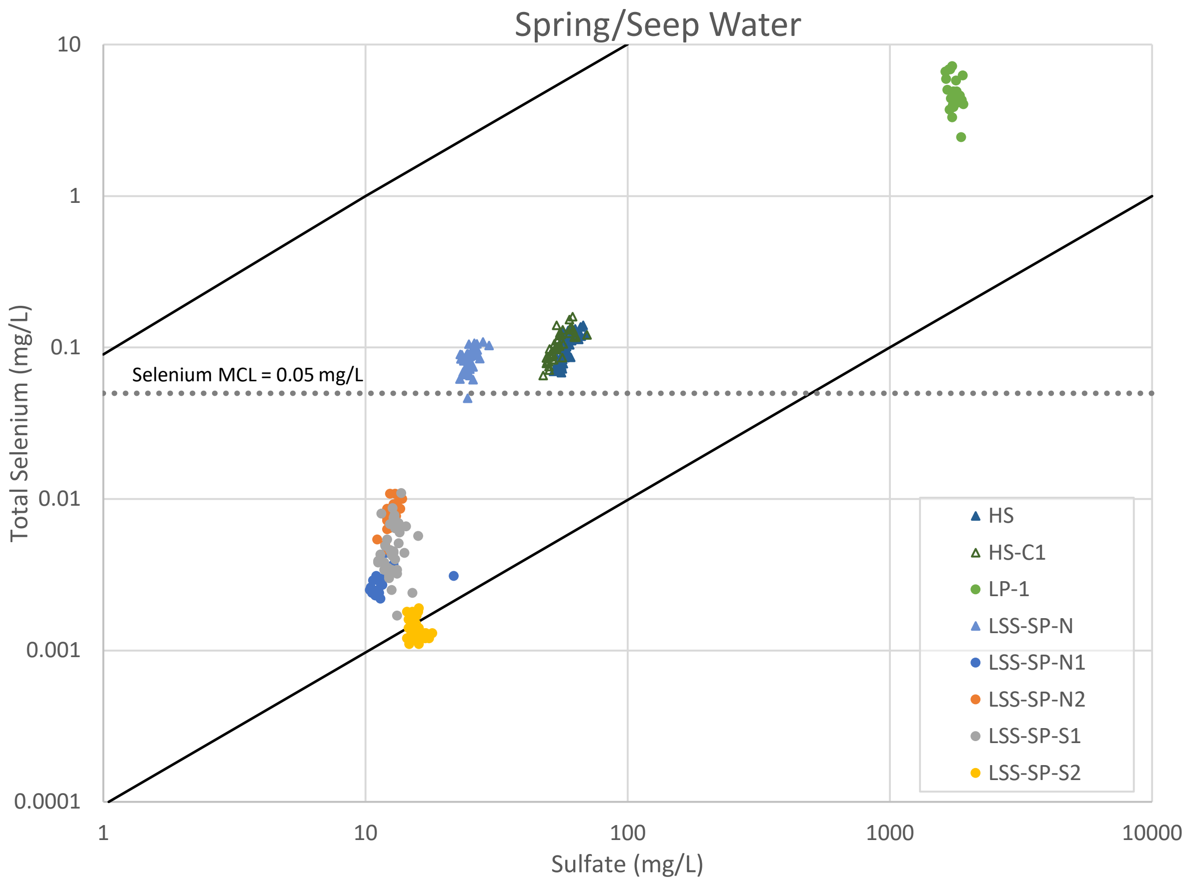
TOTAL SELENIUM VERSUS SULFATE CONCENTRATIONS IN WELLS FORMATION GROUNDWATER

DATE: APRIL 2020	
BY: LJM	FOR: ACK

FORMATION ENVIRONMENTAL

"S:\Jobs\Smoky\CERCLA\FS\FSTM2\MNA\MNA chart.xlsx"

"S:\JOBS\SMOKY\CERCLA\FS\FSTM2\FIGURES\APRILDRAFT\SECTION2\FIG2-06_SE_VS_SO4SPRINGS.PPTX"

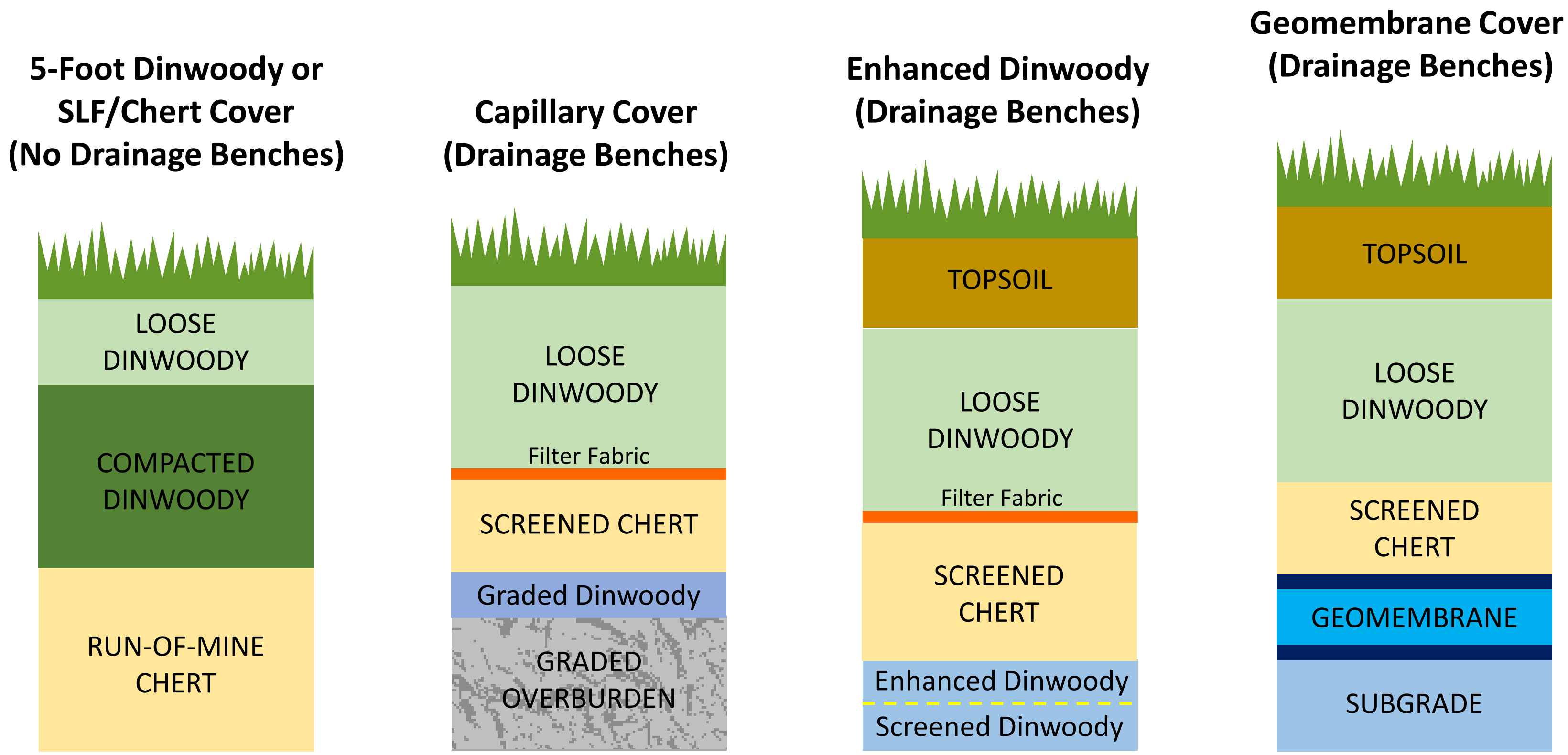


Notes:
1. mg/L = milligrams per liter
2. Data shown in plot is from 2012 to present
3. Total selenium and sulfate data is provided in Table 2-6

DRAFT

J.R. SIMPLOT COMPANY SMOKY CANYON MINE FEASIBILITY STUDY TECHNICAL MEMORANDUM #2		
FIGURE 2-6 **TOTAL SELENIUM VERSUS SULFATE CONCENTRATIONS IN SPRING/SEEP WATER**		
DATE: APRIL 2020		FORMATION ENVIRONMENTAL
BY: LJM	FOR: ACK	

"S:\Jobs\Smoky\CERCLA\FS\FSTM2\MNA\MNA chart.xlsx"



J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

FIGURE 2-7

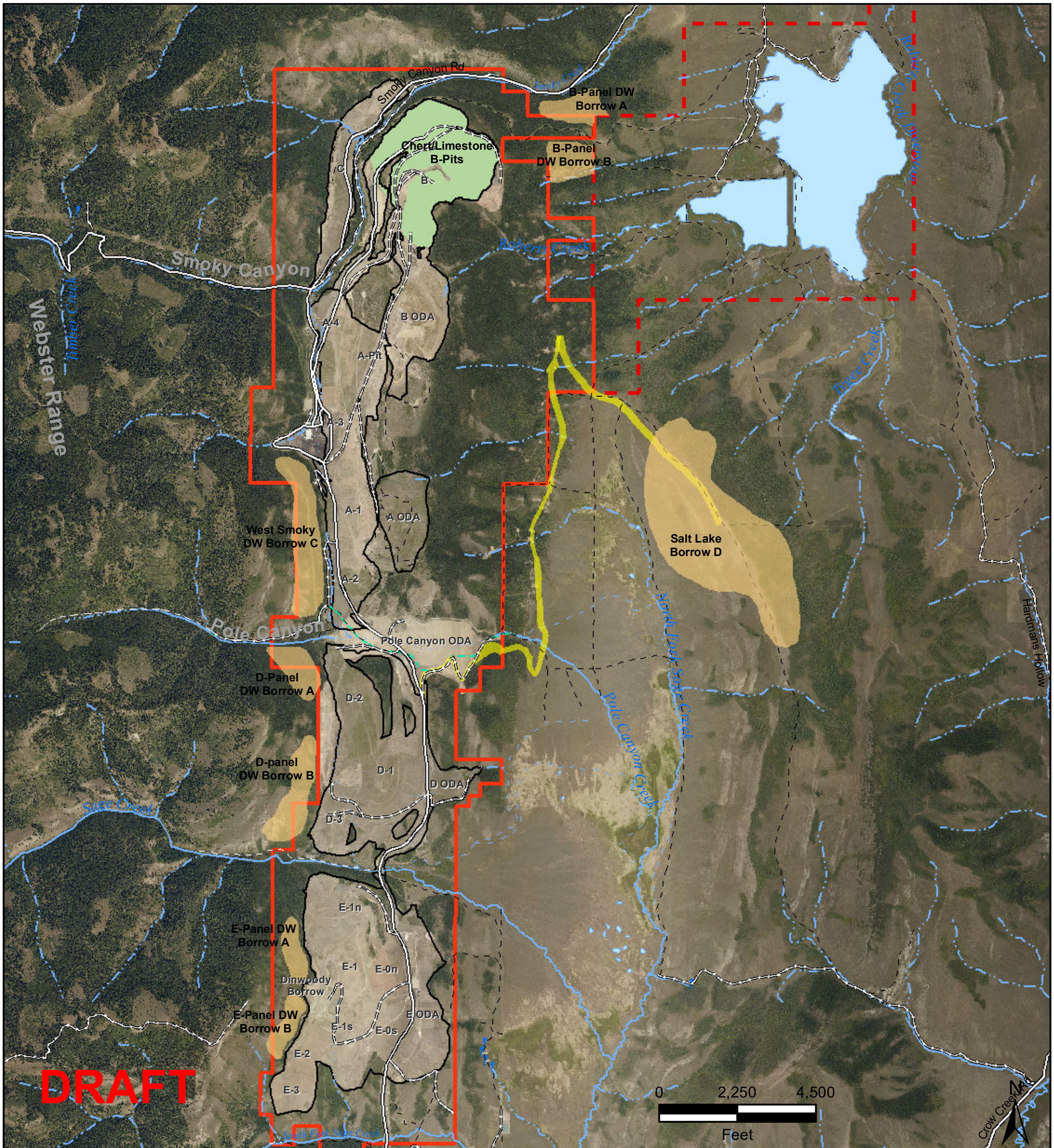
PROFILES OF COVER ALTERNATIVES

DATE: APRIL 2020	
BY: ASF	FOR: ACK

FORMATION ENVIRONMENTAL

DRAFT

S:\Jobs\Smoky\CERCLA\FS\FSTM2\Figures\AprilDraft\Section2



Legend

Minor Road	Lease Area - USDA Forest Service (USFS)
Unimproved Road	Simplot Property Boundary-Area B
Trail (4WD)	Mine Disturbance Area
Trail (Other than 4WD)	Dinwoody or Salt Lake Formation Borrow Area
	B-Pits Chert/Limestone

J.R. SIMPLOT COMPANY

SMOKY CANYON MINE RI/FS

FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

FIGURE 2-8

POTENTIAL BORROW AREAS

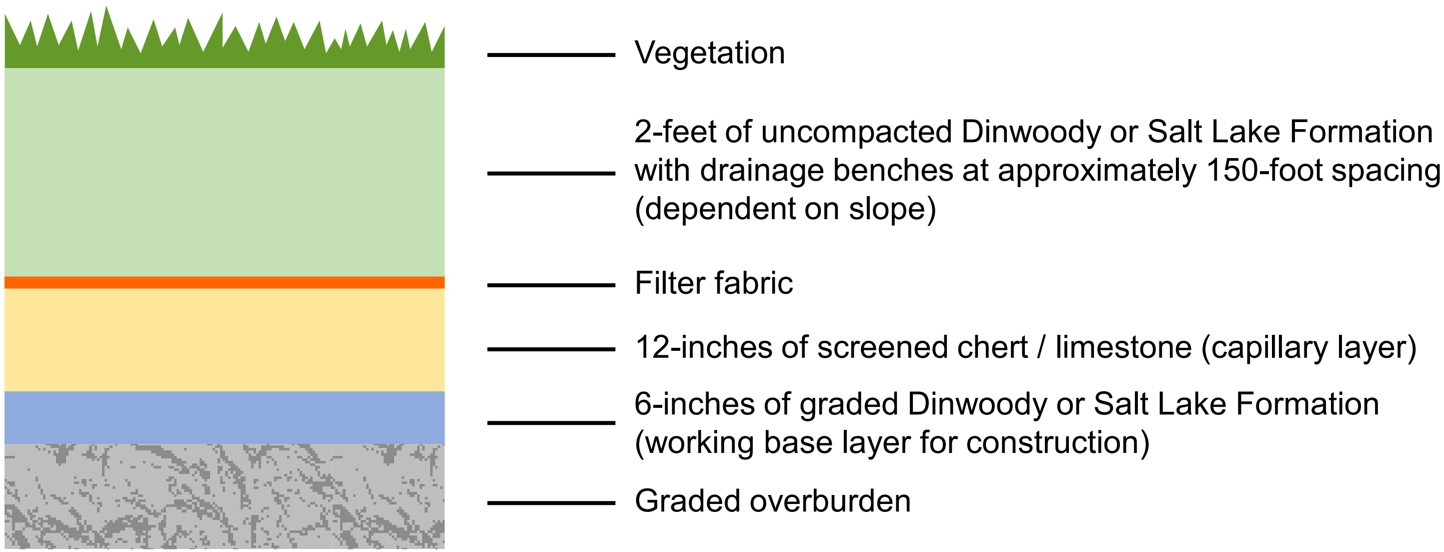
DATE: APR 01, 2020

BY: CRL | FOR: ACK

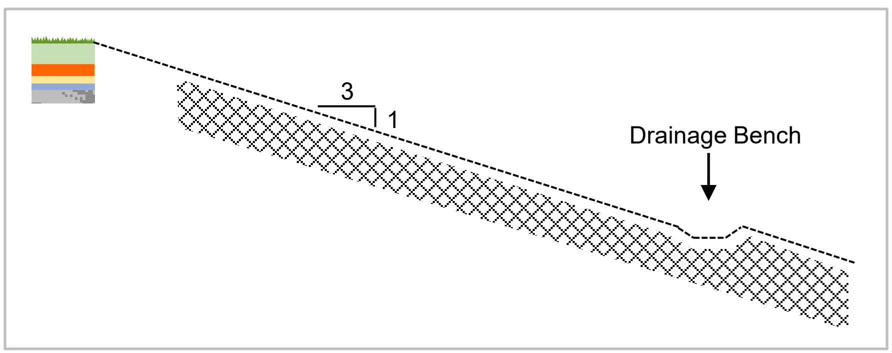
FORMATION ENVIRONMENTAL

S:\GIS\arcprj2\010109\plt\FS\TechMemo2\Section2\Fig2-08_DW_SL_Borrow.mxd

"S:\JOBS\SMOKY\CERCLA\FS\FSTM2\FIGURES\APRILDRAFT\SECTION2\FIG2-08_CAPILLARYCOVERPROFILE_V2.PPTX"



Drainage Schematic



Notes:
Not to scale
150-foot bench spacing on slope
A 20-foot wide geomembrane liner is placed at the bottom of the bench below the drainage layer and is covered with riprap.

DRAFT

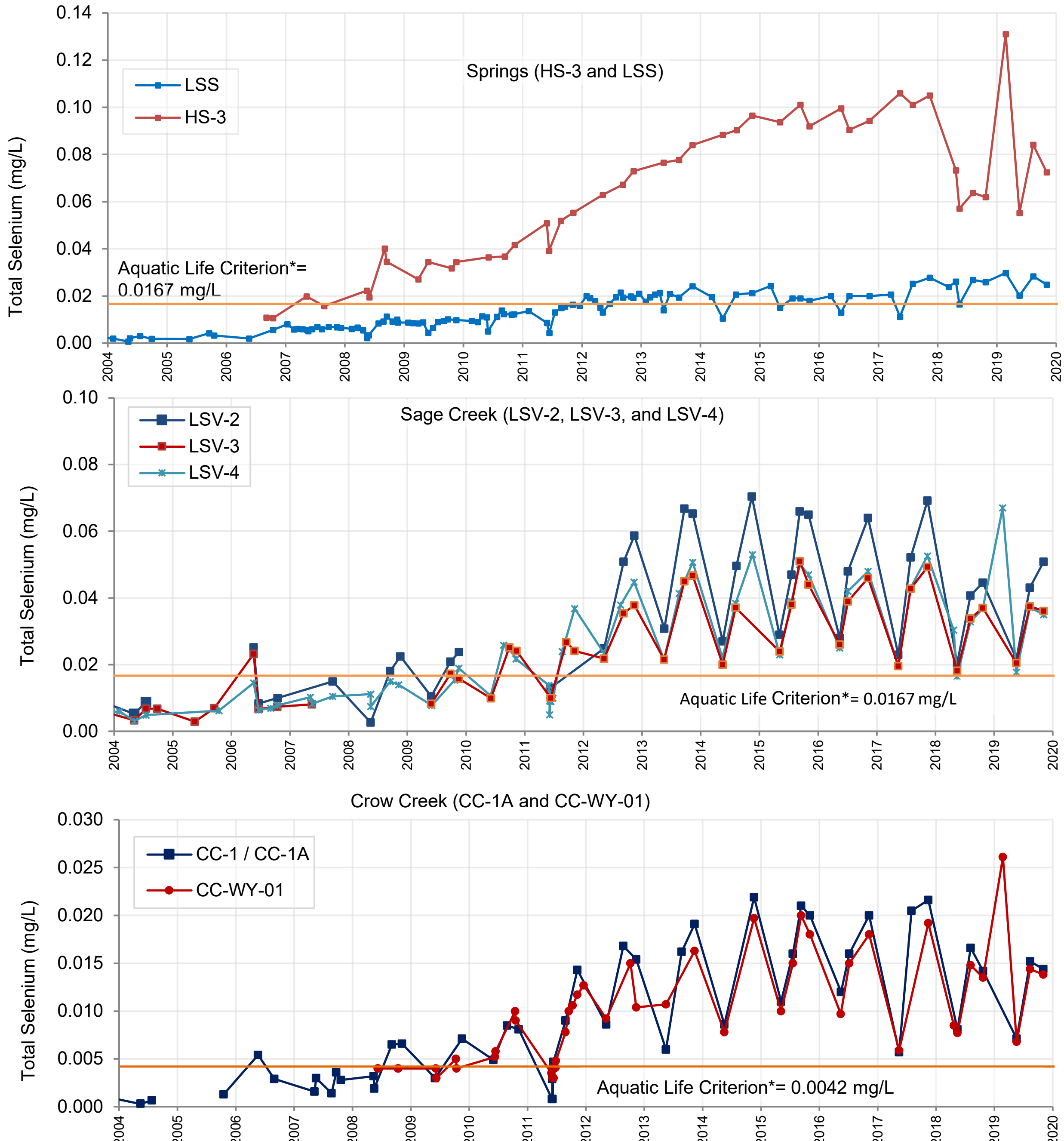
J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

FIGURE 2-9

CAPILLARY COVER PROFILE WITH DRAINAGE BENCHES

DATE: APRIL 2020
BY: ASF
FOR: ACK

FORMATION ENVIRONMENTAL



DRAFT

Notes:
1. mg/L = milligrams per liter.
2. From January 2015 to March 2017, a maximum of 250 gallons per minute (gpm) from a combination of HS, HS-C1, and LSS-SP-N were treated in Phase I of the Hoopes Spring Selenium Treatment System Pilot (TSP).
3. Since December 2017, a maximum of 2,000 gpm from a combination of HS, HS-C1, and LSS-SP-N were treated in Phase II of the Hoopes Spring Selenium TSP.
4. The Hoopes Spring Selenium TSP was off-line from January 28 through April 3, 2019 and the February 2019 samples represent the untreated condition.

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

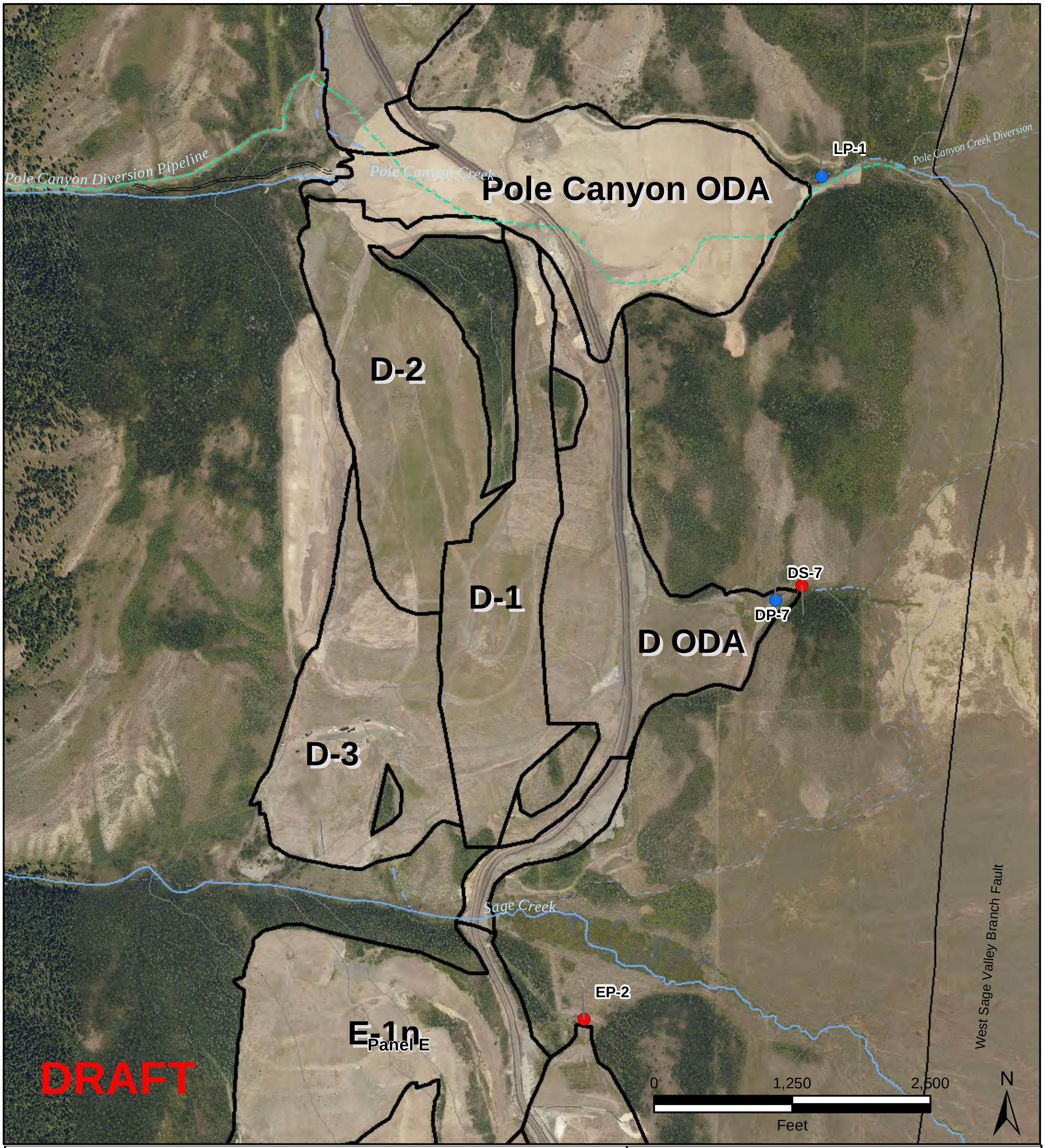
FIGURE 2-10

TOTAL SELENIUM CONCENTRATIONS IN SURFACE WATER

DATE: APRIL 2020
BY: LJM | FOR: ACK

FORMATION ENVIRONMENTAL

"S:\Jobs\Smoky\CERCLA\FS\FSTM2\Support\TimeSeries_updated20191211.xlsx"



Legend

- Seep Locations
- Detention Pond Locations
- Mine Pit

Notes:
1. Mine disturbance area boundary includes a 50-foot buffer.

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE RI/FS
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

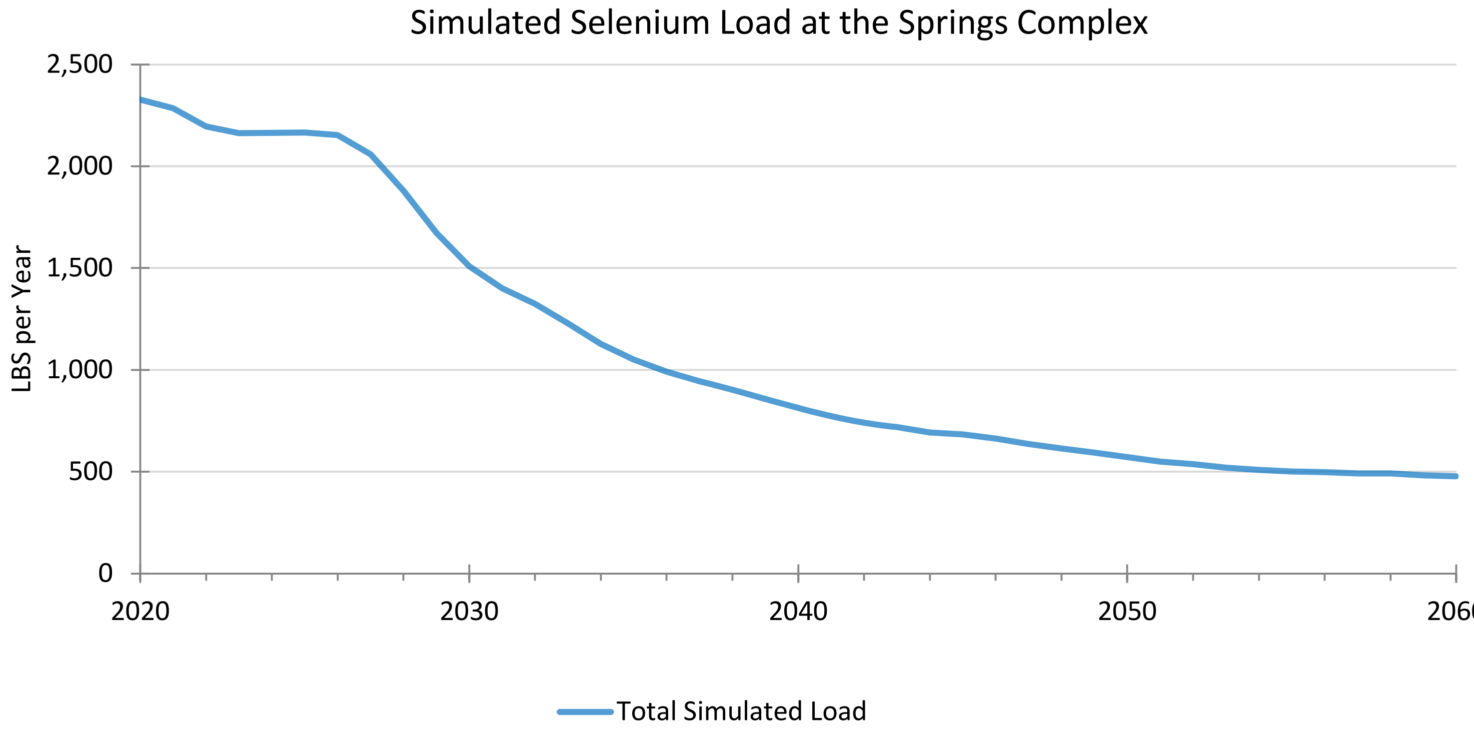
FIGURE 2-11

SURFACE WATER LOCATIONS WITH ARSENIC CONCENTRATIONS ABOVE THE MCL

DATE: APR 06, 2020
BY: CRL
FOR: ACK

FORMATION ENVIRONMENTAL

S:\GIS\arcprj2\010109\plt\FS\TechMemo2\Section2\Fig2-11_SWLocsAs.mxd



Notes:
1. LBS = Pounds

DRAFT

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

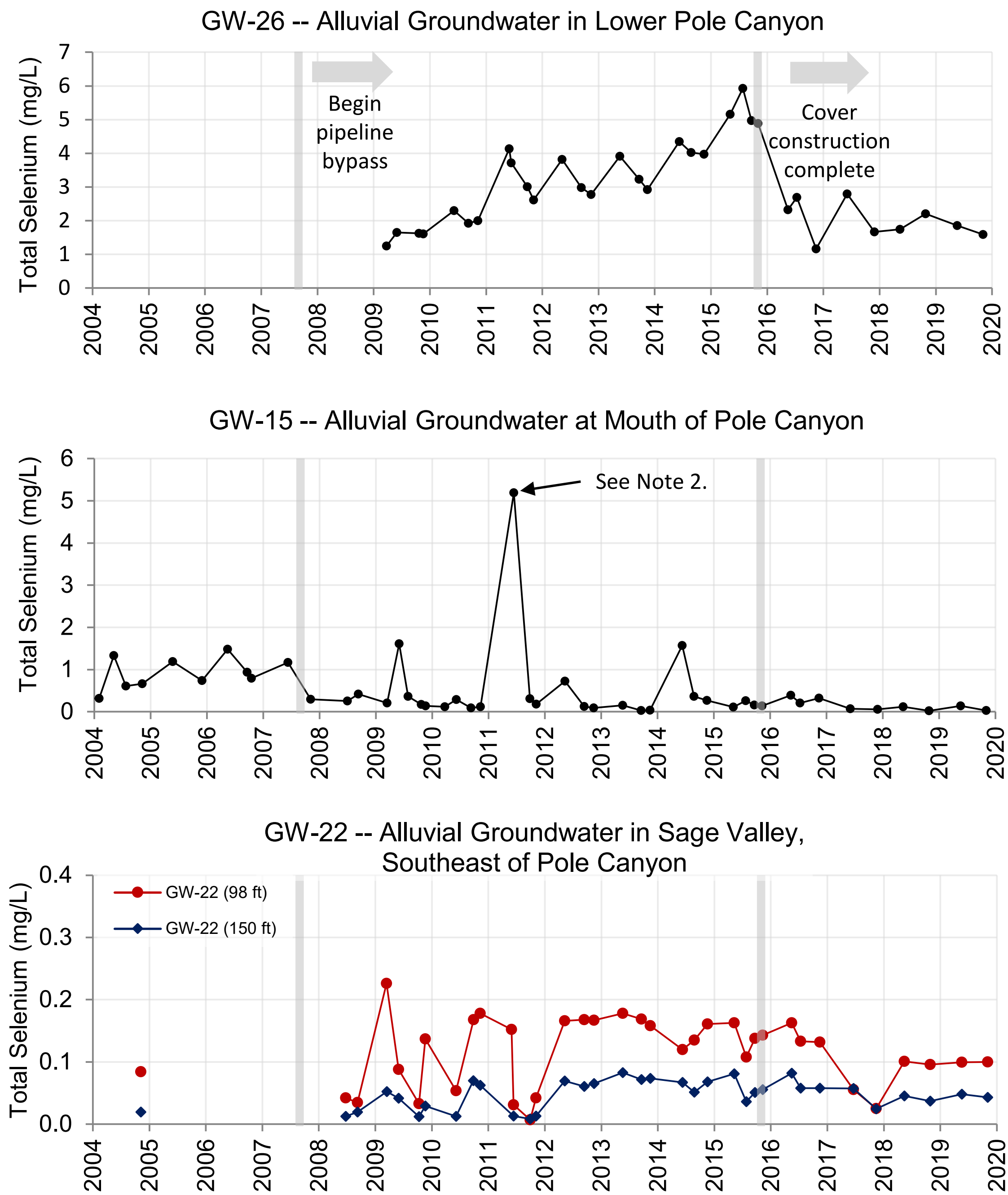
FIGURE 2-12

SIMULATED SELENIUM LOAD AT THE SPRING COMPLEX

DATE: APRIL 2020		FORMATION ENVIRONMENTAL
BY: PHT	FOR: ACK	

S:\Jobs\Smoky\CERCLA\FS\Model\GW_rev2019\FS_Model_revB\6in_BASE.xlsx Figures tab

"S:\JOBS\SMOKY\CERCLA\FS\FSTM2\FIGURES\APRILDRAFT\SECTION2\FIG2-13_GW26_GW22_GW15.PPTX"



DRAFT

Notes:

1. mg/L = milligrams per liter
2. Per an agreement between USFS and Simplot, upper Pole Canyon Creek flow was diverted to the infiltration basin downstream of the bypass pipeline inlet from November 11, 2010 through June 2, 2011 and from June 8 through 10, 2011. Greater than expected spring runoff overtopped the infiltration basin and flowed into the Pole Canyon ODA. The elevated June 15, 2011 selenium concentration observed at GW-15 is likely a result of increased load discharging from the Pole Canyon toe seep (LP-1) and less clean water recharge to the alluvial aquifer downgradient of the pipeline outlet (LP-PD).

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

FIGURE 2-13

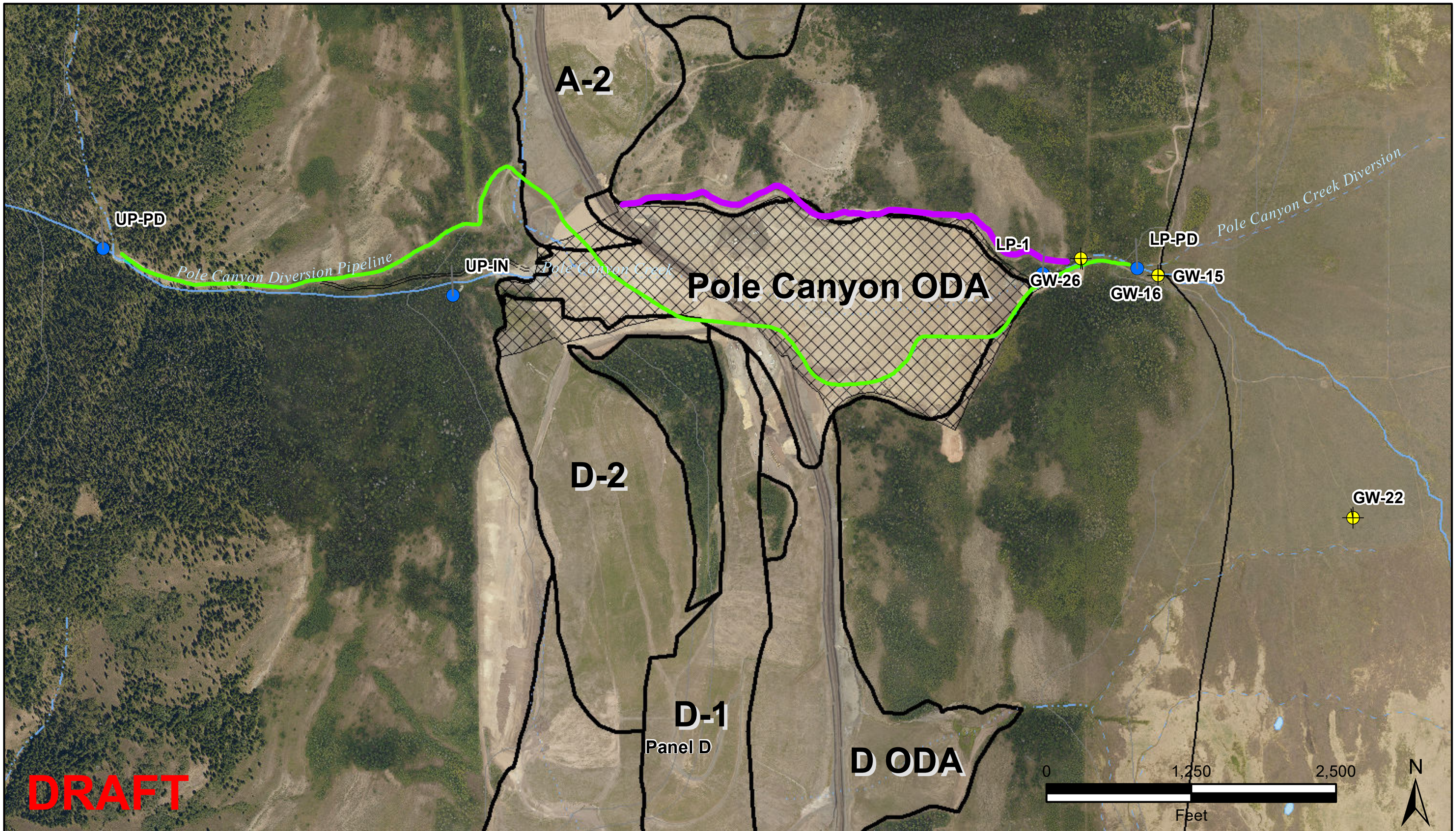
TOTAL SELENIUM CONCENTRATIONS IN ALLUVIAL GROUNDWATER (GW-26, GW-15, GW-22)

DATE: APRIL 2020

BY: PHT FOR: ACK

FORMATION ENVIRONMENTAL

S:\Jobs\Smoky\CERCLA\FS\FSTM2\Support\TimeSeries_updated20191211.xlsx



Legend

- Surface Water Monitoring Locations
- Alluvial Monitoring Wells
- Pole Canyon Creek Bypass Pipeline
- Run-on Control Channel
- Perennial Stream
- Intemittent Stream
- Canal Ditch
- Historic Flow Path
- Pipeline
- Lake/Pond
- Reservoir
- Swamp/Marsh
- Mine Pit
- Dinwoody/Chert Cover on Pole Canyon ODA (120 acres)
- Geology_Mansfield

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE RI/FS
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

FIGURE 2-14

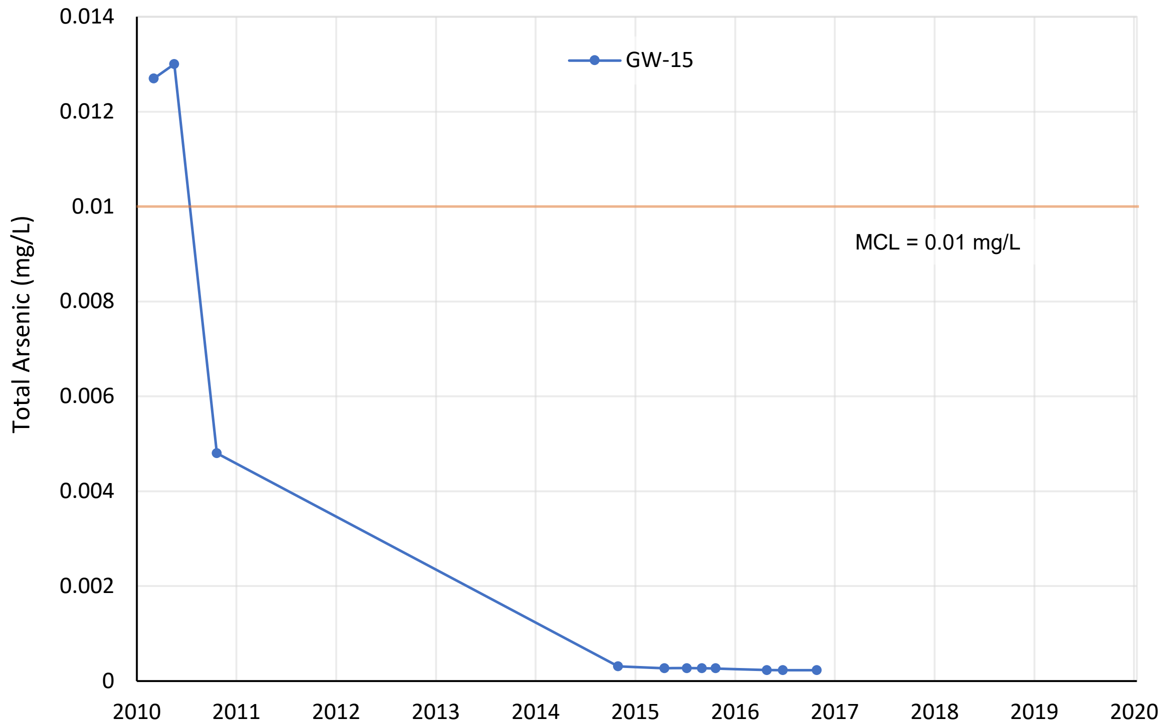
ALLUVIAL MONITORING LOCATIONS IN POLE CANYON AND SAGE VALLEY

DATE: APR 01, 2020

BY: CRL | FOR: ACK

FORMATION ENVIRONMENTAL

S:\GIS\arcprj\2010109\plt\FS\TechMemo2\Section2\Fig2-14_AlluvialMonLocs.mxd



Notes:
1. mg/L = milliigrams per liter
2. MCL = Maximum contaminant level

DRAFT

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

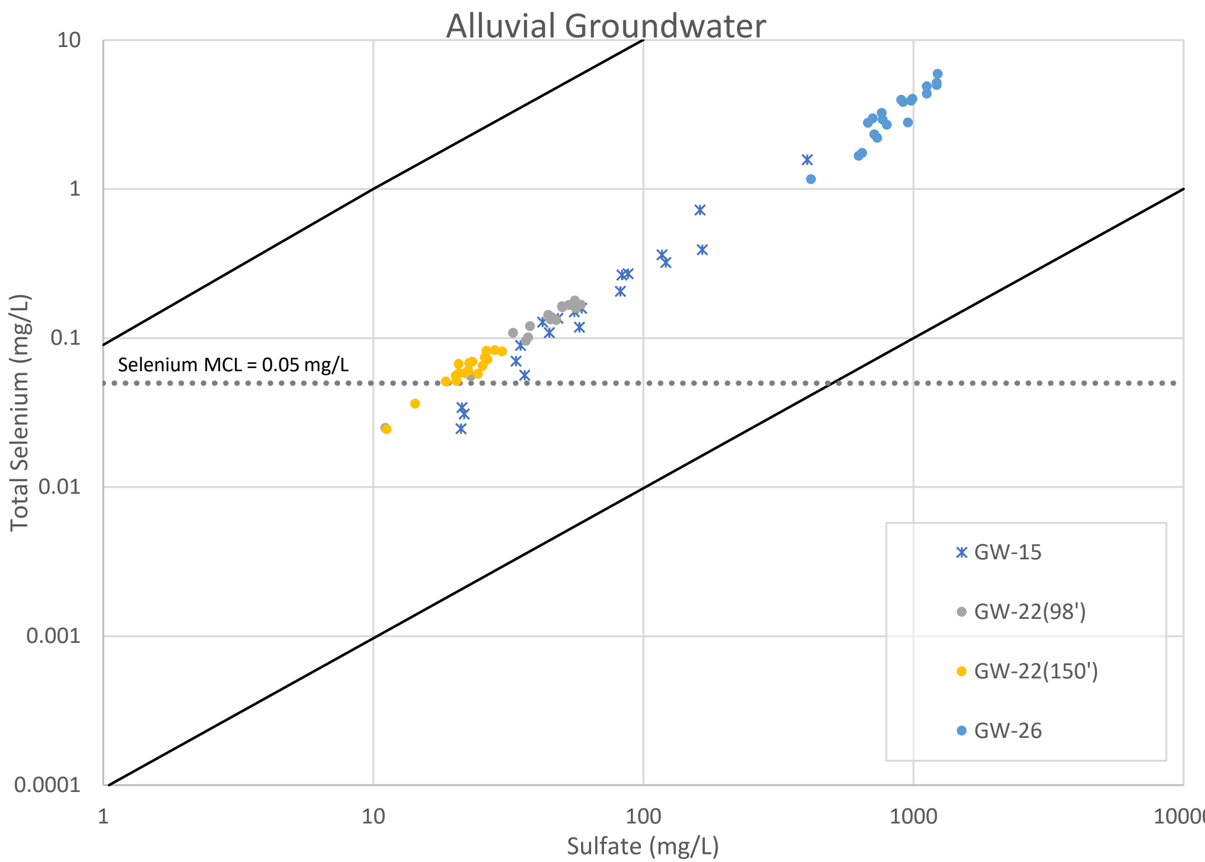
FIGURE 2-15

ARSENIC CONCENTRATIONS IN ALLUVIAL GROUNDWATER AT THE MOUTH OF POLE CANYON (GW-15)

DATE: APRIL 2020
BY: WSB
FOR: ACK

FORMATION ENVIRONMENTAL

S:\Jobs\Smoky\CERCLA\FS\FSTM2\Support\Copy of ArsenicTimeSeries_20190606.xlsx



Notes:
1. mg/L = milligrams per liter.
2. Data show in plot is from 2012 to present.
3. Total selenium and sulfate data is provided in Table 2-6.

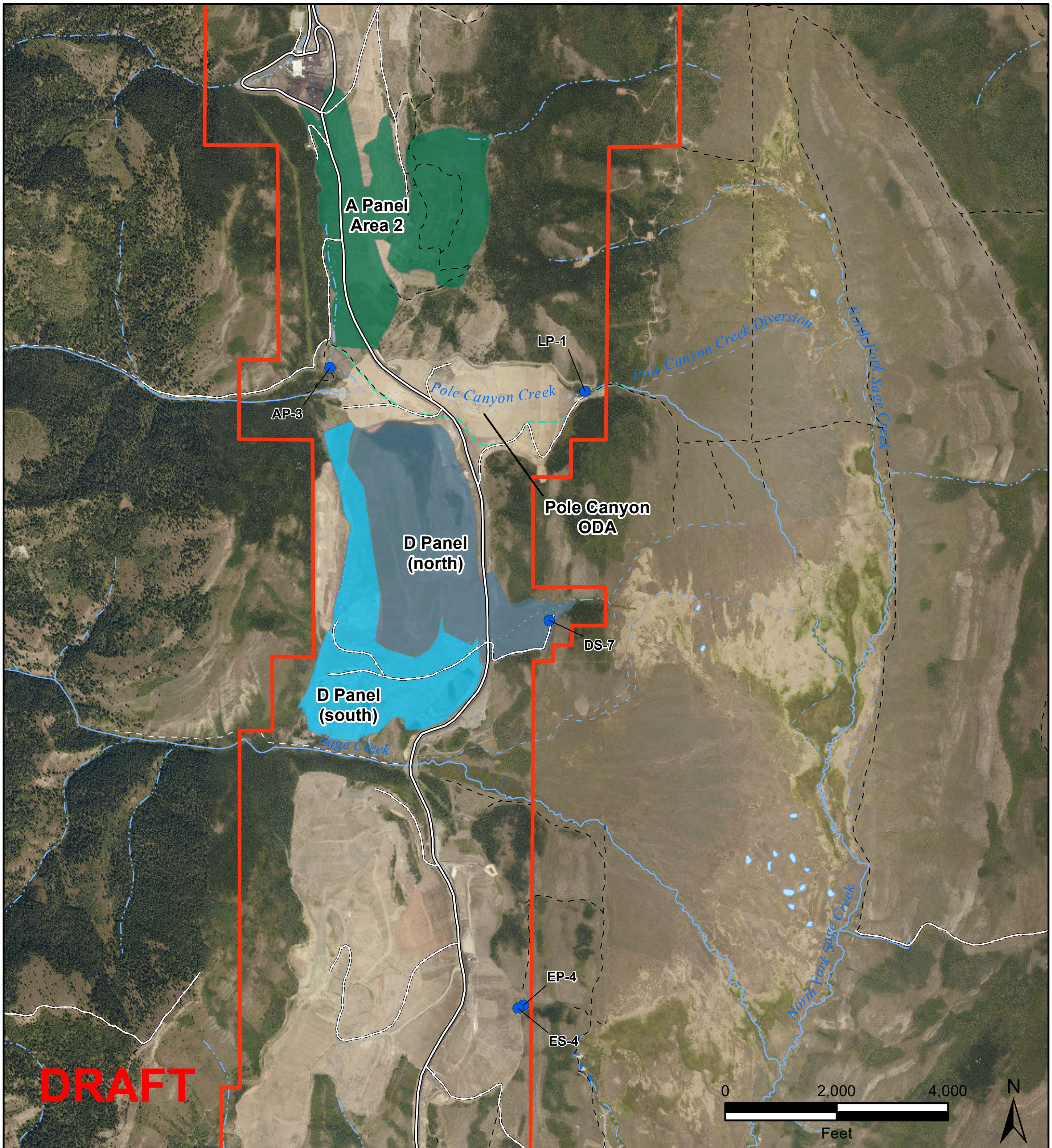
DRAFT

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

FIGURE 2-16

TOTAL SELENIUM VERSUS SULFATE CONCENTRATIONS IN ALLUVIAL GROUNDWATER

DATE: APRIL 2020		FORMATION ENVIRONMENTAL
BY: LJM	FOR: ACK	



Legend

- Soil Sample Location
- Perennial Stream
- Intemittent Stream
- Canal Ditch
- Historic Flow Path
- Pipeline
- Lease Area
- Lake/Pond

Sampling Areas with Elevated Selenium Risk

- Panel A (Area 2)
- Panel D (north)
- Panel D (south)

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE RI/FS
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

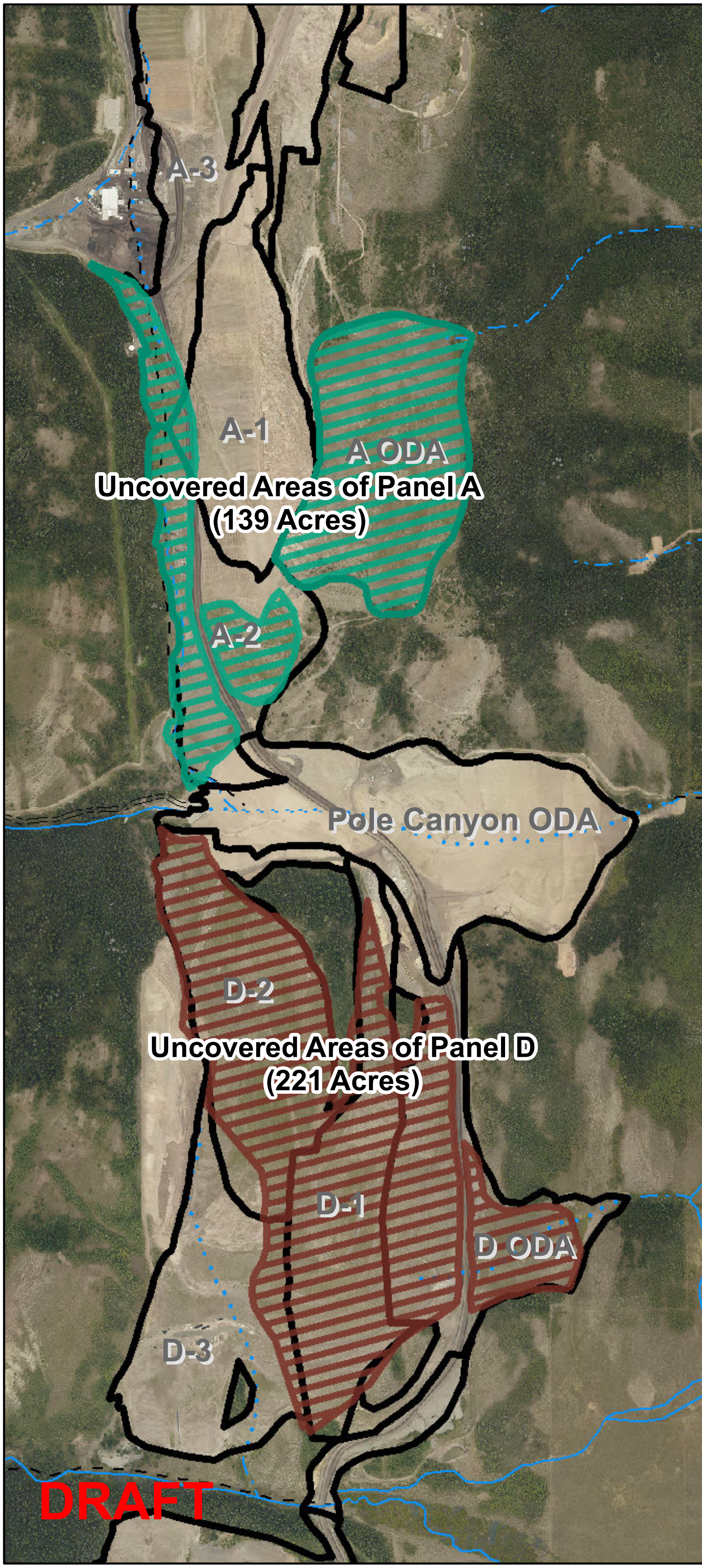
FIGURE 2-17

AREAS WITH ELEVATED ARSENIC AND SELENIUM CONCENTRATIONS IN SOIL

DATE: APR 01, 2020
BY: CRL | FOR: ACK

FORMATION ENVIRONMENTAL

S:\GIS\arcprj2\010109\plt\FS\TechMemo2\Section2\Fig2-17_ElevatedSe_As_Soil.mxd



Legend

Panel A Proposed Reclamation Cover

Panel D Proposed Reclamation Cover

Mine Pit

0 1,500 3,000

Feet

N

J.R. SIMPLOT COMPANY

SMOKY CANYON MINE RI/FS

FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

FIGURE 2-18

UNCOVERED AREAS OF PANELS A AND D FOR FS COVERS

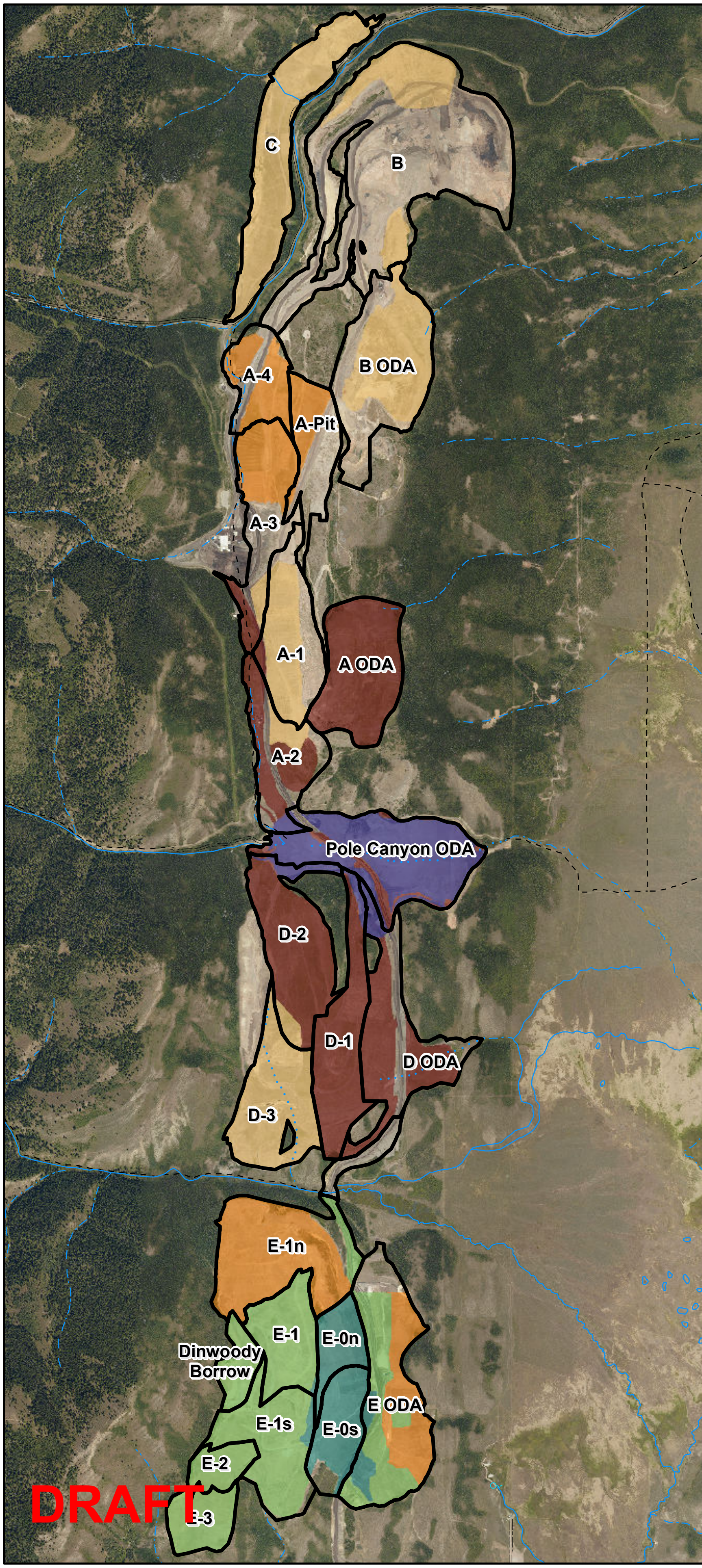
DATE: APR 01, 2020

BY: CRL

FOR: ACK

FORMATION ENVIRONMENTAL

S:\GIS\arcprj2\010109\plt\FS\TechMemo2\Section2\Fig2-18_UncoveredAandD.mxd



Legend

Post-Mining Reclamation (Updated 2017)

- Panel E Cover (PEC)
- Deep Dinwoody Cover (DDC)
- Pole Canyon Cover (PCC)
- Old Topsoil Chert Cover (OTC)
- Panels B and C Cover (PBC)
- Thin Topsoil/No Cover (TTC)
- Mine Pit

0 3,000 6,000
Feet

N

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE RI/FS
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

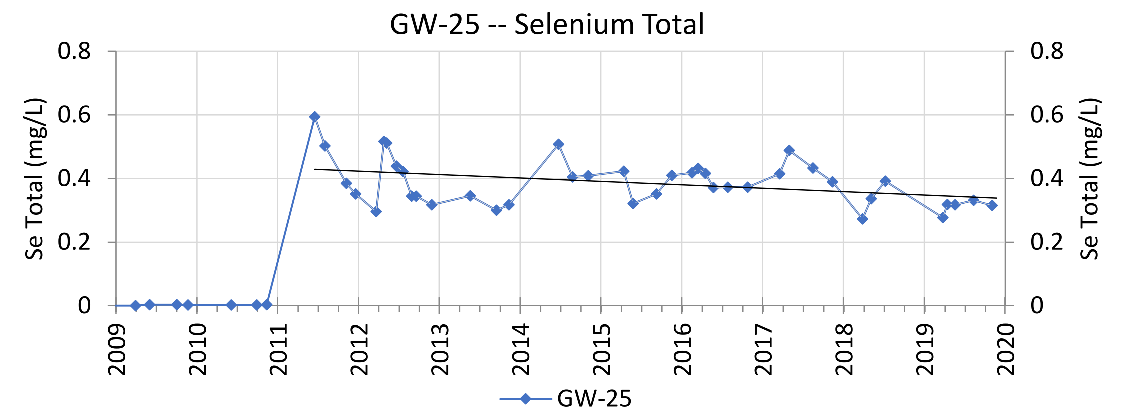
FIGURE 3-1

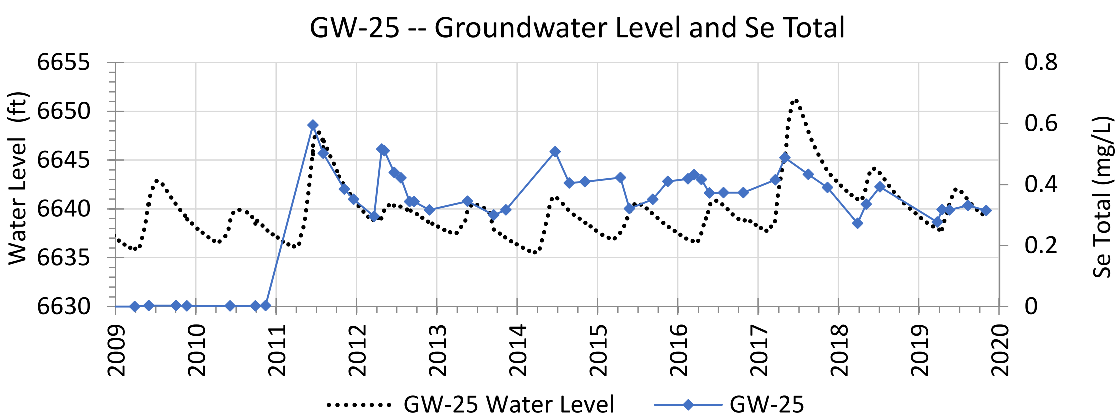
EXTENT OF COVERS INSTALLED DURING POST-MINING RECLAMATION AND THE 2013 POLE CANYON NTCRA

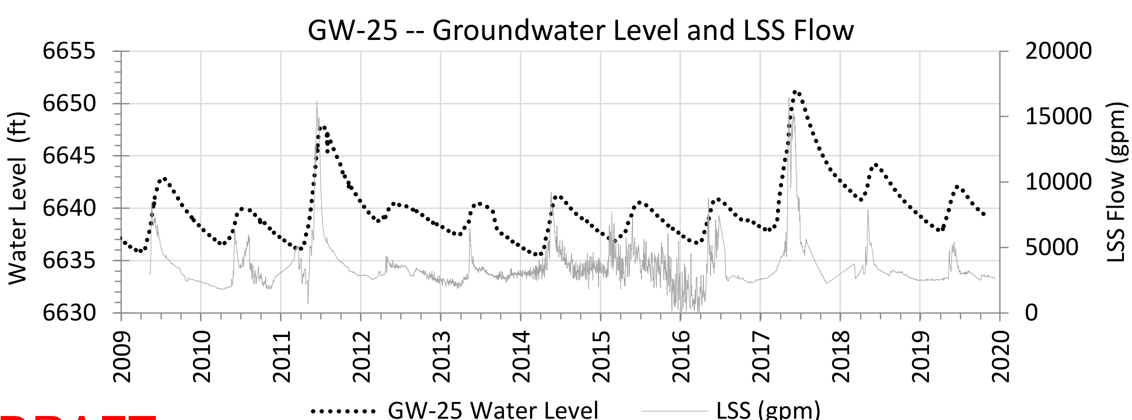
DATE: APR 01, 2020		FORMATION ENVIRONMENTAL
BY: CRL	FOR: ACK	

S:\GIS\arcprj2\010109\plt\FS\TechMemo2\Section3\Fig3-01_AllCovers.mxd

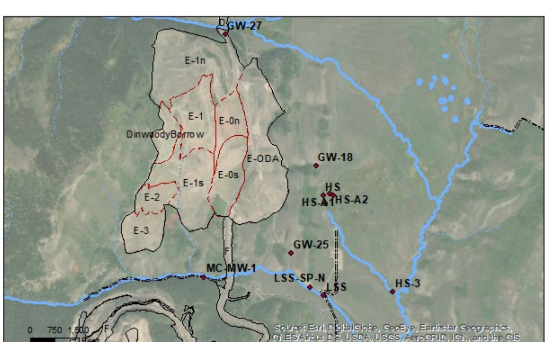
"S:\JOBS\SMOKY\CERCLA\FS\FSTM2\FIGURES\APRILDRAFT\SECTION3\FIG3-02_WELLSGWPANELE.PPTX"







DRAFT



J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

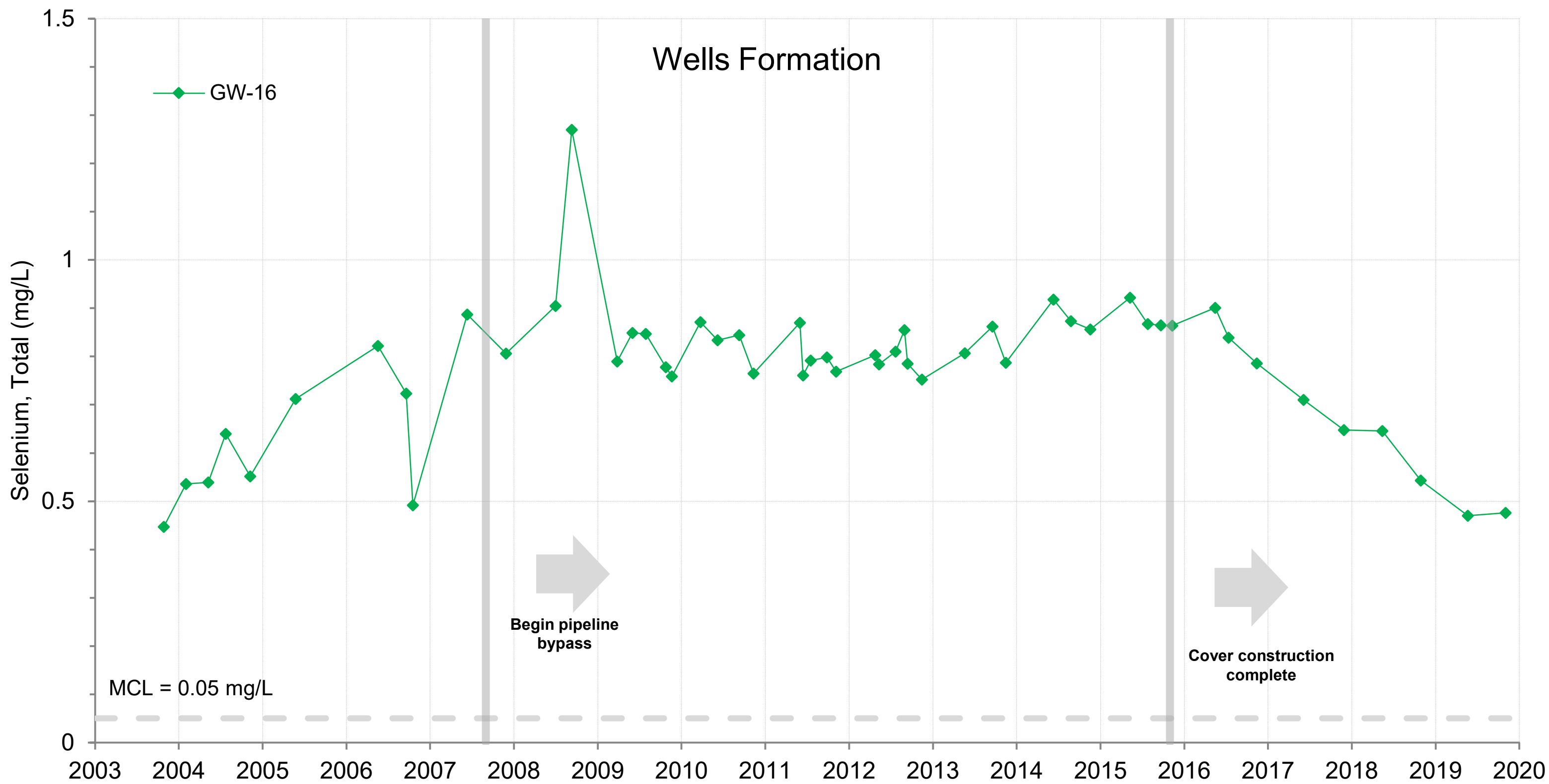
FIGURE 3-2

SELENIUM CONCENTRATIONS IN WELLS FORMATION GROUNDWATER DOWNGRADIENT OF PANEL E (GW-25)

DATE: APRIL 2020
BY: WSB
FOR: ACK

FORMATION ENVIRONMENTAL

S:\GIS\arcprj2\simplot_id\Database\DataExtracts\PHT\SmokyAnalysis.xlsx



Notes:
1. mg/L = milligrams per liter

DRAFT

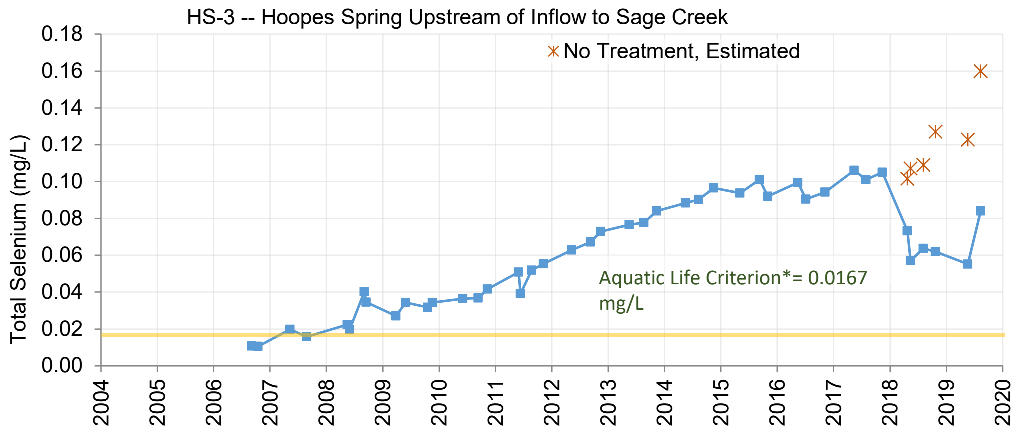
J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

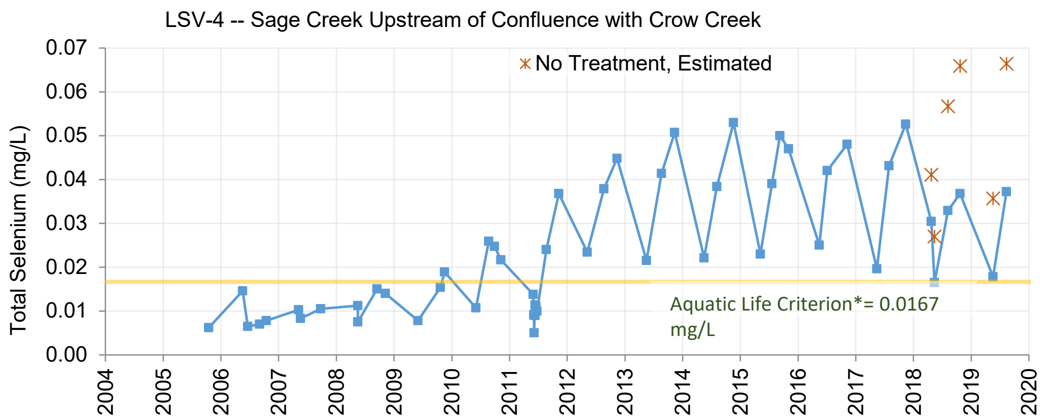
FIGURE 3-3

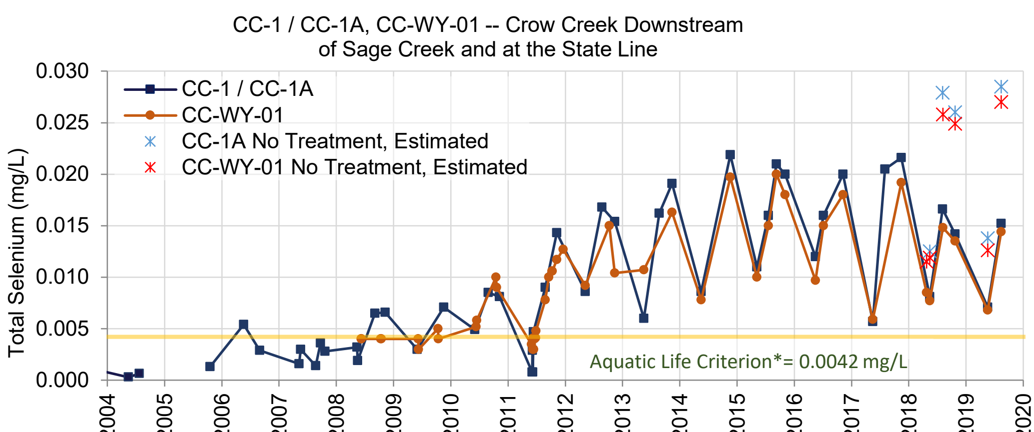
SELENIUM CONCENTRATIONS IN WELLS FORMATION GROUNDWATER DOWNGRADIENT OF POLE CANYON ODA (GW-16)

DATE: APRIL 2020		FORMATION ENVIRONMENTAL
BY: LJM	FOR: AKC	

S:\Jobs\Smoky\CERCLA\FS\FSTM2\Support\TimeSeries_updated20191211.xlsx







Notes:
1. mg/L = milligrams per liter

DRAFT

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

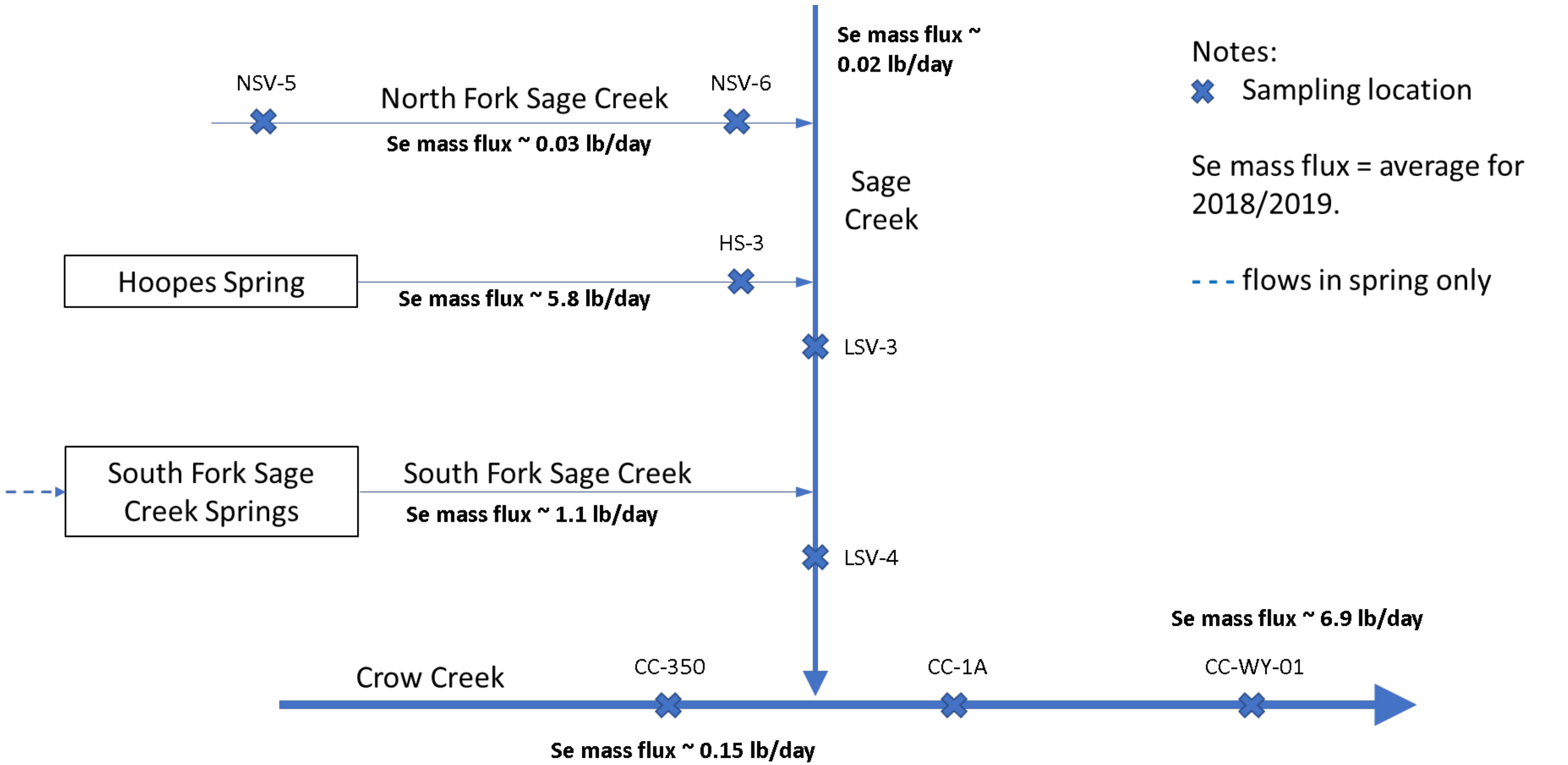
FIGURE 3-4

SELENIUM CONCENTRATIONS IN SURFACE WATER IN SAGE CREEK AND CROW CREEK

DATE: APRIL 2020
BY: PHT
FOR: ACK

FORMATION ENVIRONMENTAL

S:\Jobs\Smoky\CERCLA\FS\FSTM2\SupportWaterTreatmentDS_TimeSeriesv2_ack.xlsx

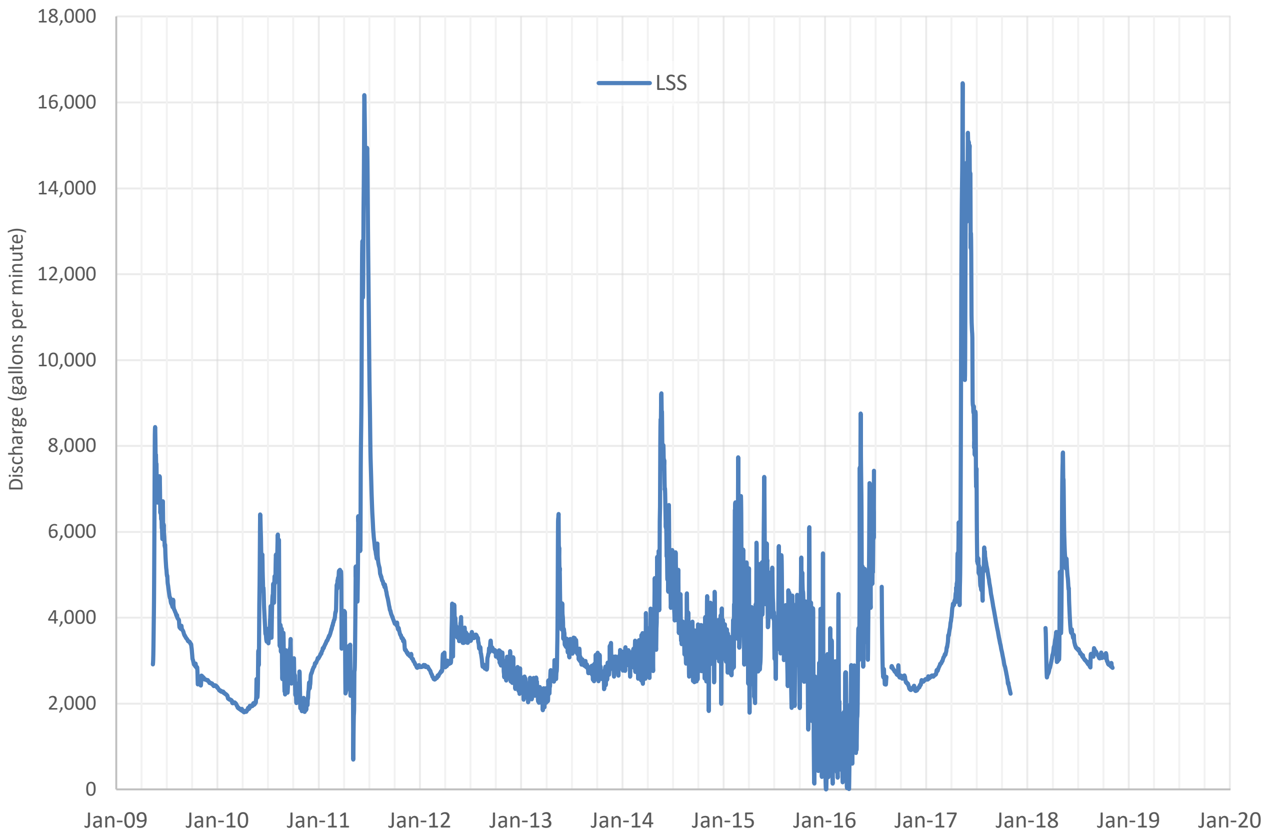


Note:
1. Mass flux estimates based on measured flows and Se concentrations.
2. ~ = approximately

DRAFT

J.R. SIMPLOT COMPANY SMOKY CANYON MINE FEASIBILITY STUDY TECHNICAL MEMORANDUM #2		
FIGURE 3-5 **SELENIUM LOAD MODEL FOR SAGE CREEK/ CROW CREEK**		
DATE: APRIL 2020		FORMATION ENVIRONMENTAL
BY: WSB	FOR: ACK	

"S:\JOBS\SMOKY\CERCLA\FS\FSTM2\FIGURES\APRILDRAFT\SECTION3\FIG3-06A_HYDROGRAPHLSS.PPTX"



DRAFT

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

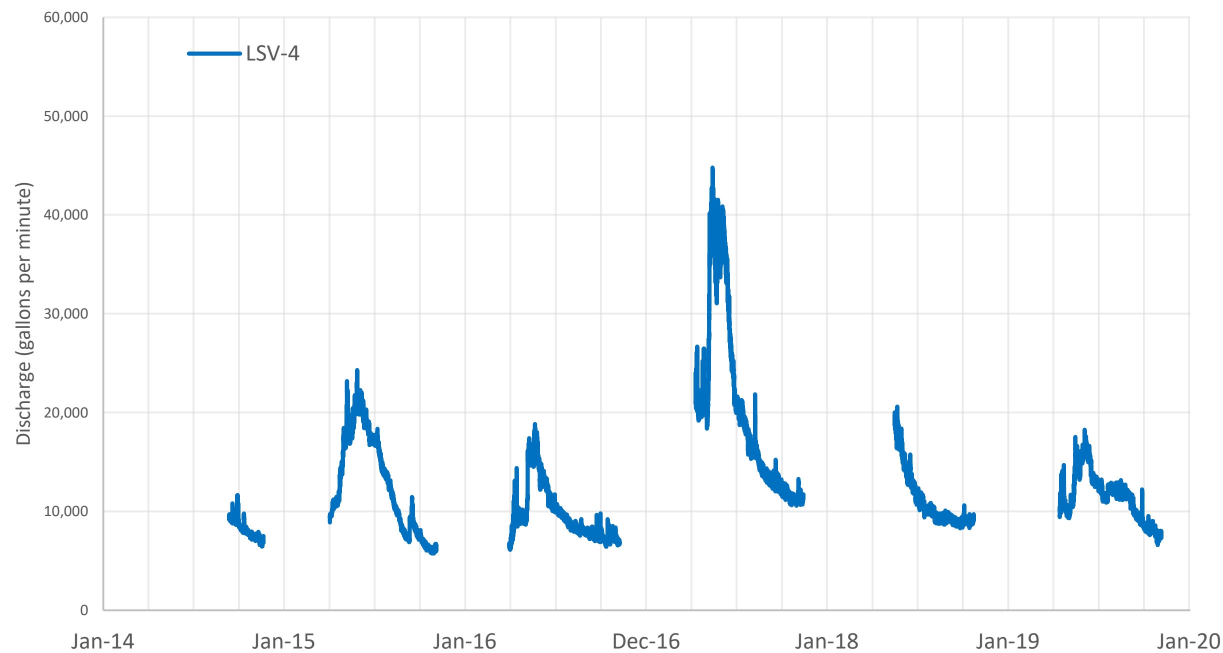
FIGURE 3-6a

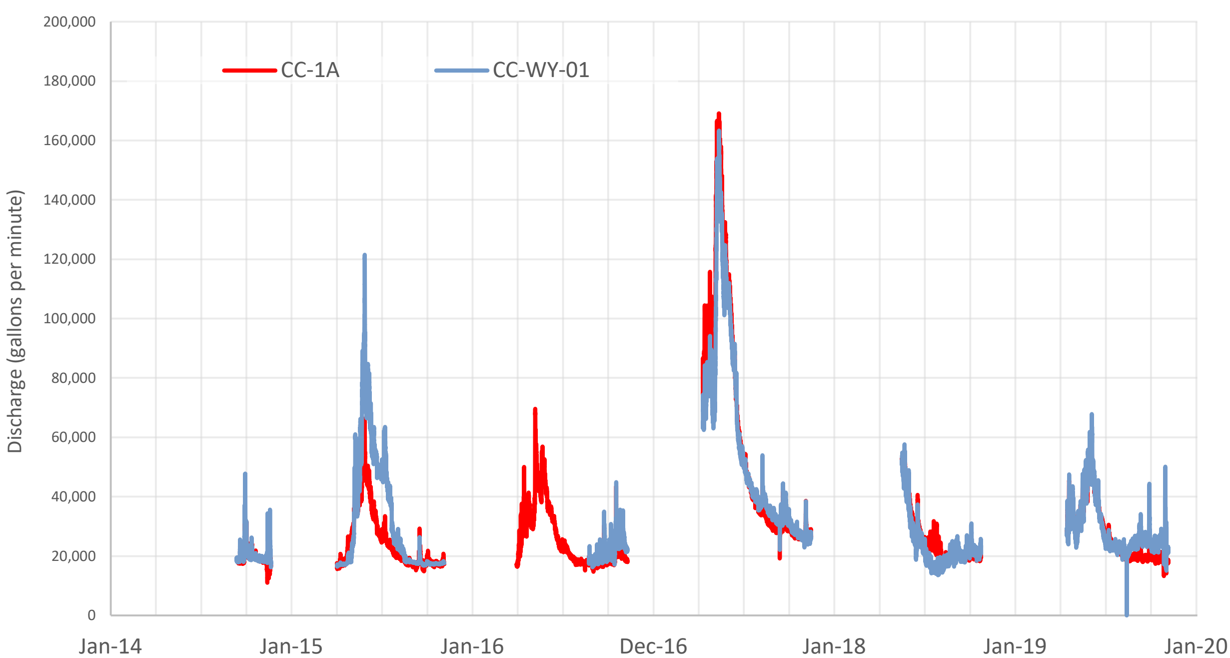
HYDROGRAPHS FOR SELECT LOCATIONS IN THE SAGE CREEK/CROW CREEK WATERSHED (LSS)

DATE: APRIL 2020
BY: WSB
FOR: ACK

FORMATION ENVIRONMENTAL

"S:\Jobs\Smoky\CERCLA\FS\FSTM2\Support\Streamflow\Hydrographs_ack.xlsx"





DRAFT

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

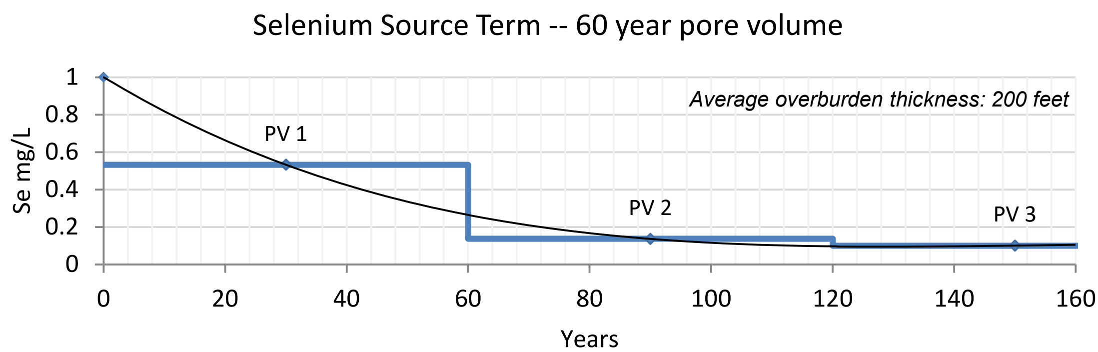
FIGURE 3-6b

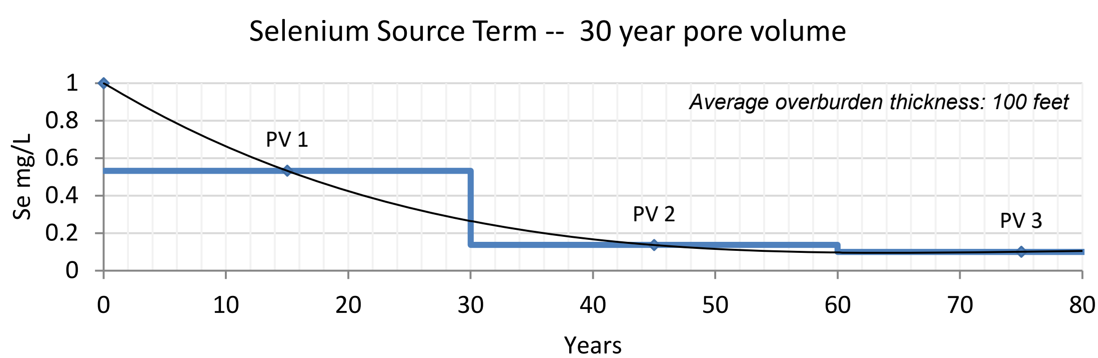
HYDROGRAPHS FOR SELECT LOCATIONS IN THE SAGE CREEK/CROW CREEK WATERSHED (LSV-4, CC-1A, CC-WY-01)

DATE: APRIL 2020
BY: WSB
FOR: ACK

FORMATION ENVIRONMENTAL

"S:\Jobs\Smoky\CERCLA\FS\FSTM2\Support\Streamflow\Hydrographs_ack.xlsx"





PV	*Panel F Backfill and External Fill (mg/L)*
1	*0.532*
2	*0.136*
3	*0.1*
5	*0.055*
7	*0.059*
9	*0.046*
10	*0.08*

DRAFT

Notes:

Pore volume (PV) to time conversion is based on time for one pore volume to infiltrate through overburden:

$$\frac{Overburden\ Thickness\ *\ Porosity\ contributing\ to\ flow}{Annual\ Infiltration\ Rate}$$

Average thickness = 100 ft and 200 ft
Porosity contributing to flow = 0.15
Infiltration rate = 6 inches per year

PV concentrations based on "Panel F Backfill and External Fill" column leach tests (JBR 2007).

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

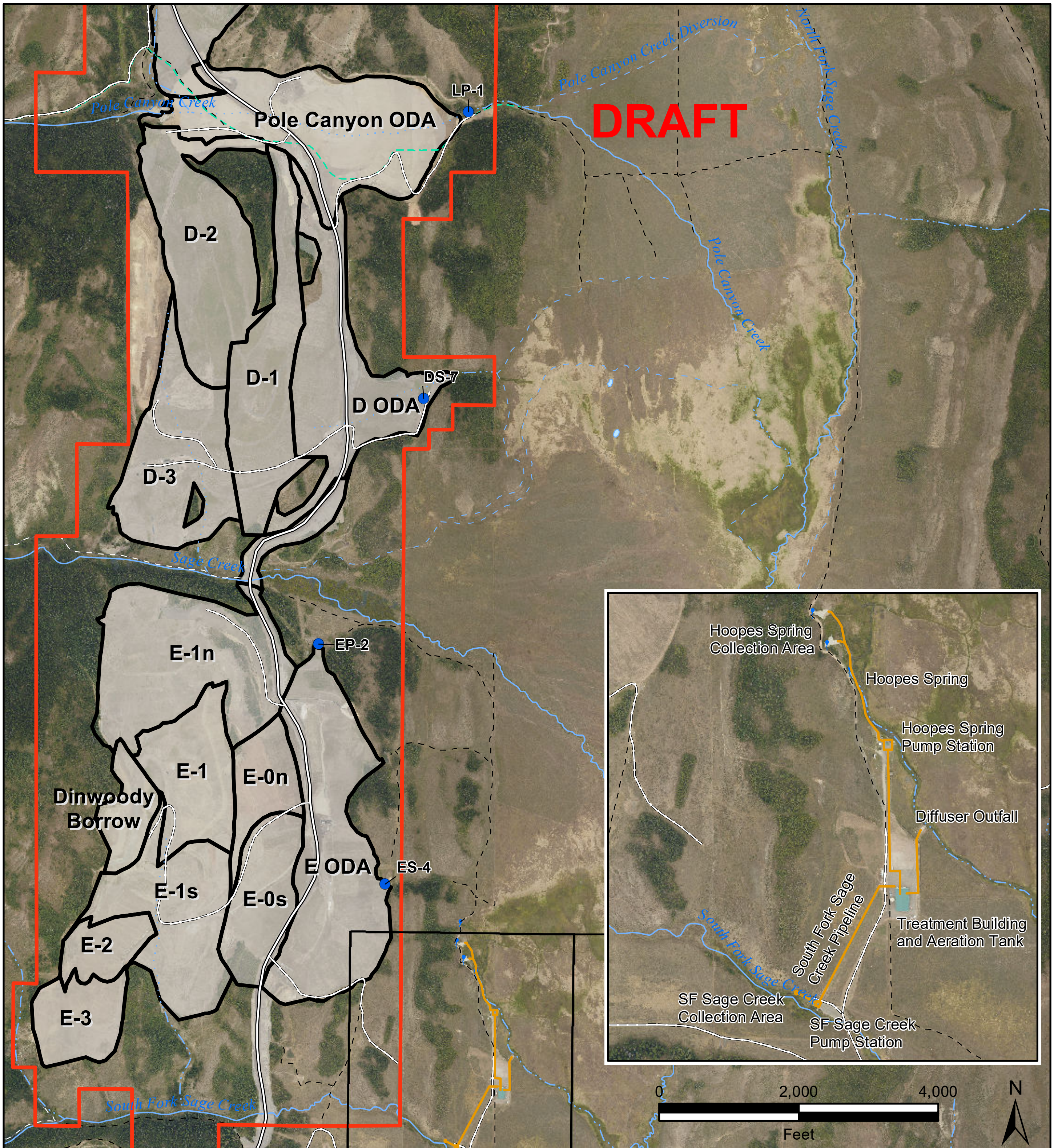
FIGURE 3-7

ESTIMATED SELENIUM SOURCE TERMS

DATE: APRIL 2020
BY: PHT
FOR: ACK

FORMATION ENVIRONMENTAL

"S:\Jobs\Smoky\CERCLA\FS\Model\GW_rev2019\SrcTerm_GW25.xlsx"



Legend

- Rock Cover on Seeps/Ponds
- Perennial Stream
- Intemittent Stream
- Canal Ditch
- Historic Flow Path
- Pipeline
- Lake/Pond
- Mine Disturbance Area
- Lease Area
- Water Treatment Plant Pipeline

J.R. SIMPLOT COMPANY

SMOKY CANYON MINE RI/FS
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

FIGURE 3-8

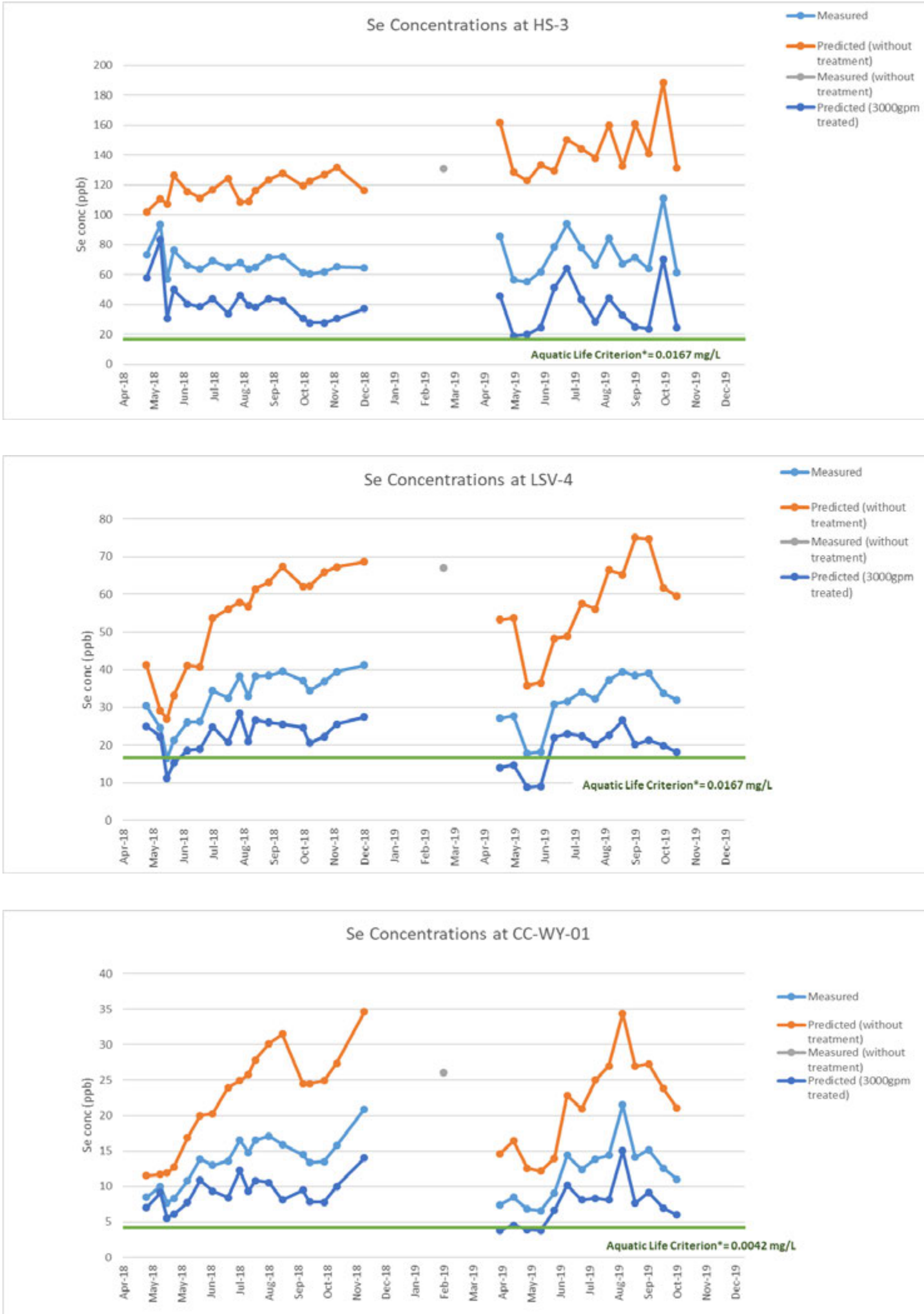
ALTERNATIVES SW-6A/6B TREATMENT OF WATER DISCHARGING AT HOOPES SPRING

DATE: APR 01, 2020

BY: CRL | FOR: ACK

FORMATION ENVIRONMENTAL

S:\GIS\arcprj2\010109\plt\FS\TechMemo2\Section3\Fig3-08_SW6a_6b.mxd



Notes:
1. ppb = Part Per Billion

DRAFT

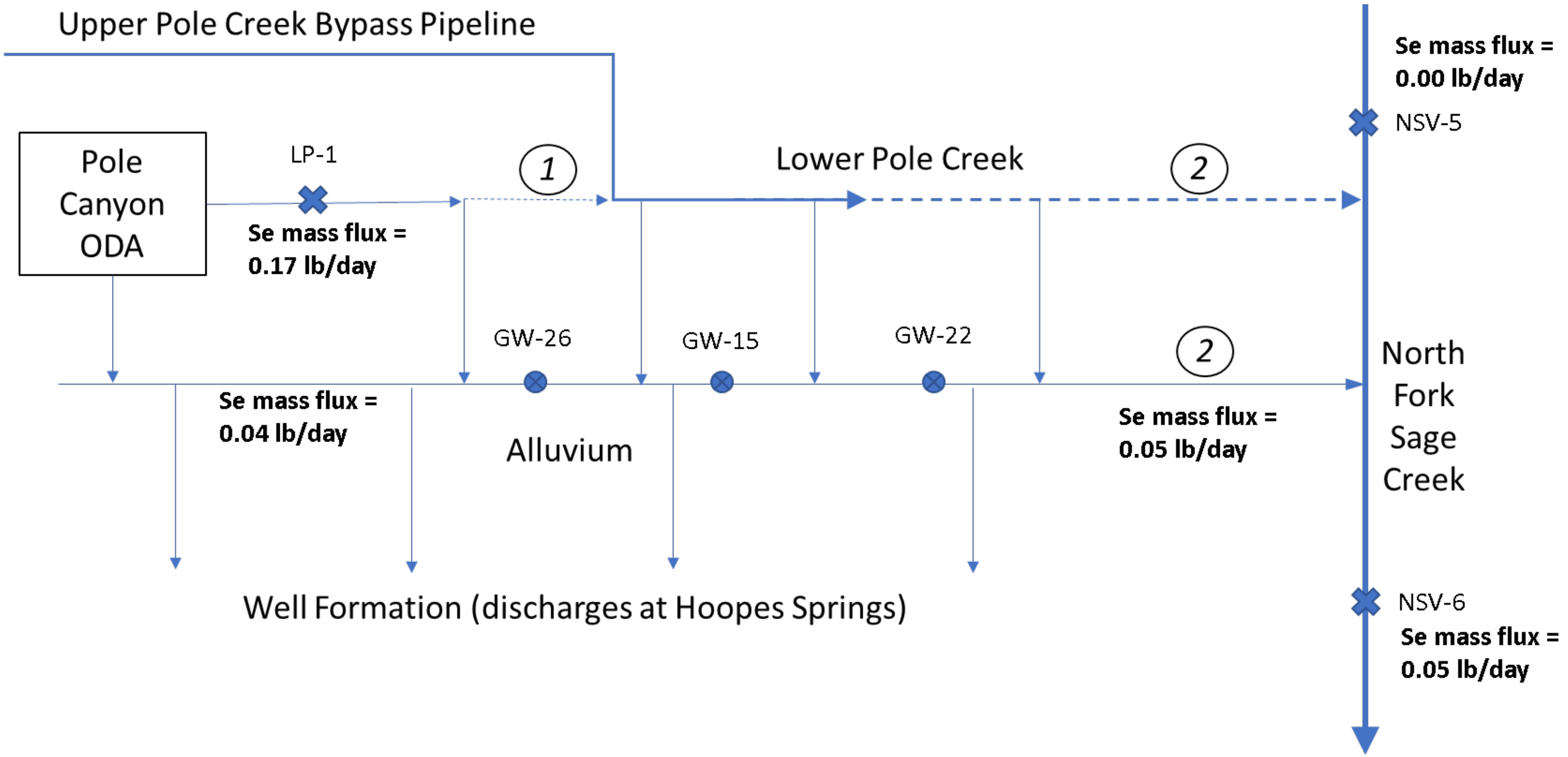
J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

FIGURE 3-9

MODEL PREDICTIONS OF SELENIUM CONCENTRATIONS IN SURFACE WATER DOWNSTREAM OF HOOPES SPRING

DATE: APRIL 2020
BY: PHT FOR: ACK

FORMATION ENVIRONMENTAL



Notes:

1. Flow at LP-1 has not been observed to reach the pipeline outflow except in the 2011 upset condition.
2. Partial surface flow and shallow alluvial flow in this area. Diffuse discharge to North Fork Sage Creek.

DRAFT

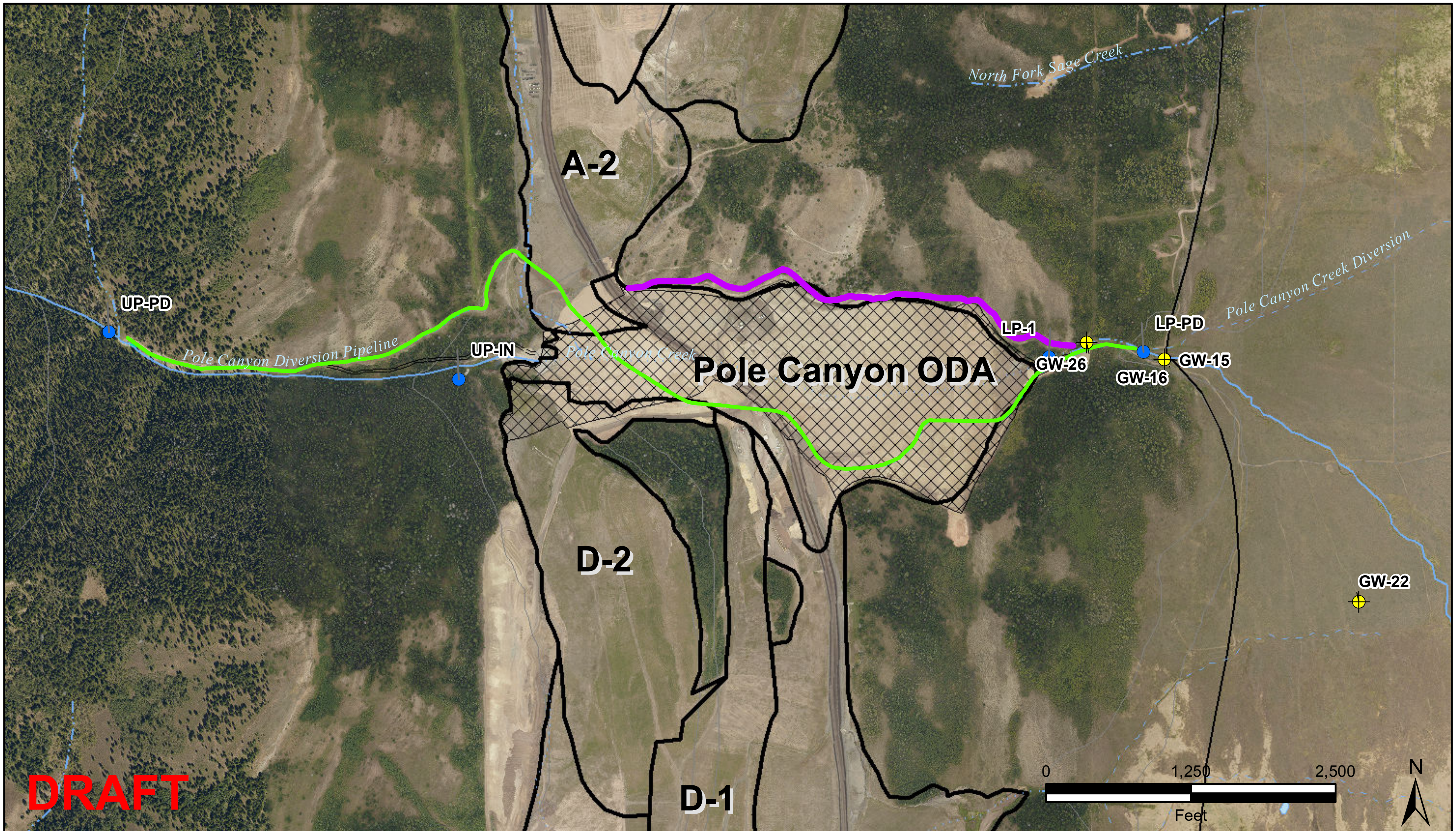
J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

FIGURE 3-10

SELENIUM LOAD MODEL FOR POLE CANYON ODA

DATE: APRIL 2020
BY: WSB
FOR: ACK

FORMATION ENVIRONMENTAL



Legend

Alluvial Monitoring Wells	Run-on Control Channel
Surface Water Monitoring Locations	Dinwoody/Chert Cover on Pole Canyon ODA (120 acres)
Pole Canyon Creek Bypass Pipeline	

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE RI/FS
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

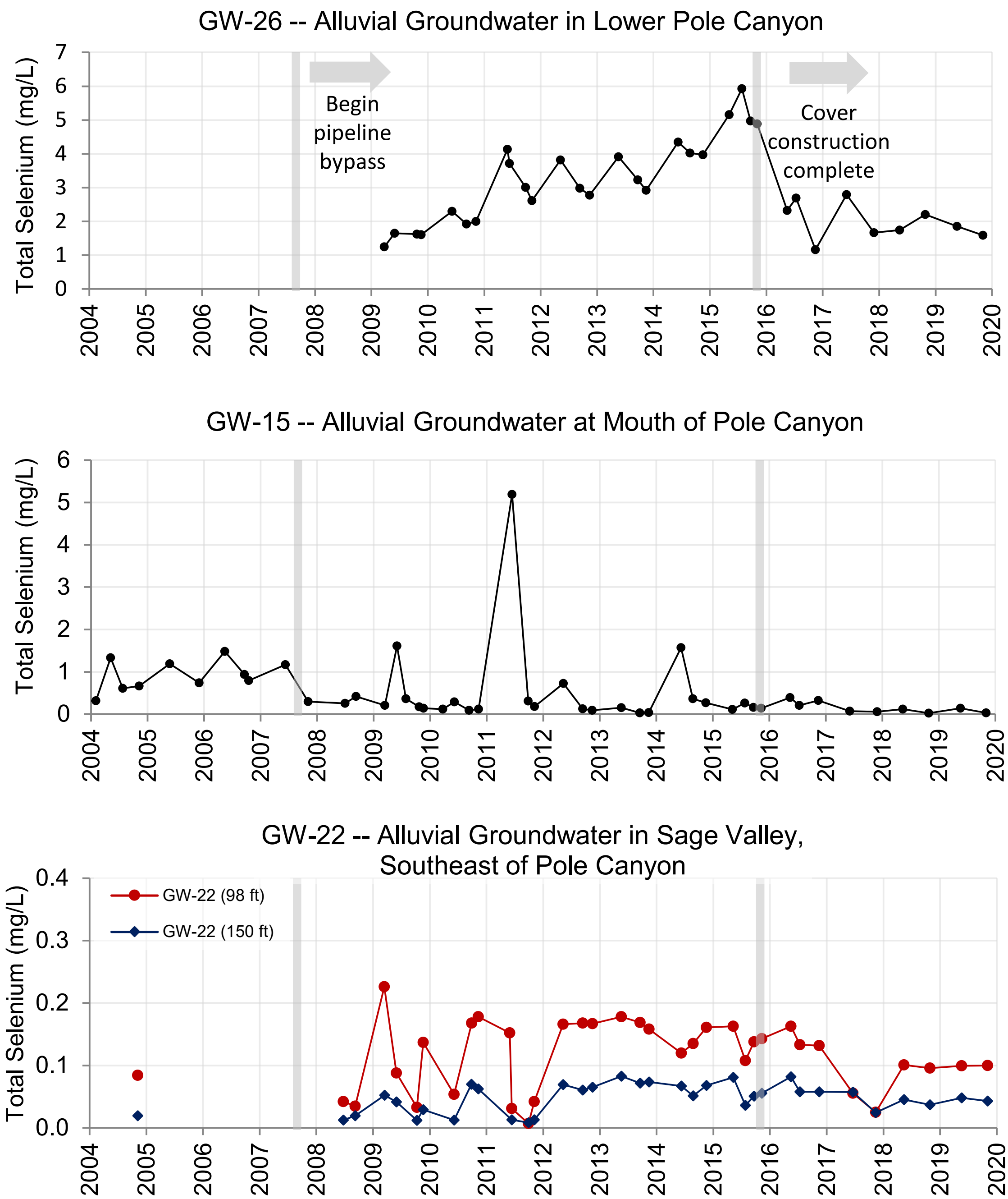
FIGURE 3-11

ALLUVIAL WELLS DOWNGRADIENT OF THE POLE CANYON ODA

DATE: APR 01, 2020
BY: CRL | FOR: ACK

FORMATION ENVIRONMENTAL

S:\GIS\arcprj2010109\plt\FS\TechMemo2\Section3\Fig3-11_AlluvialWells.mxd



Notes:
1. mg/L = milligrams per liter

DRAFT

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

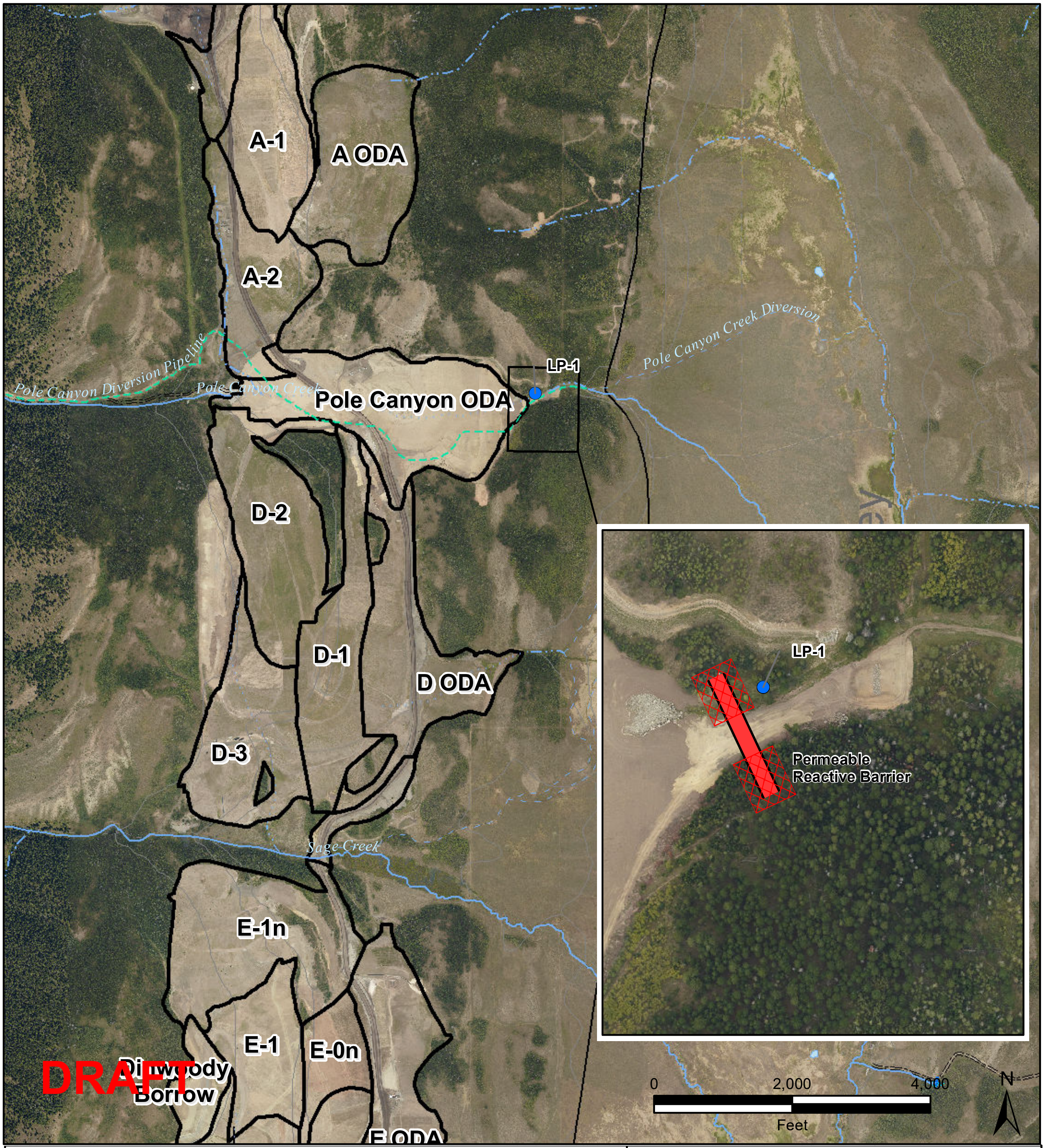
FIGURE 3-12

SELENIUM CONCENTRATIONS IN ALLUVIAL GROUNDWATER DOWNGRADIENT OF POLE CANYON ODA (GW-26, GW-15, GW-22)

DATE:APRIL 2020
BY: LJM
FOR: ACK

FORMATION ENVIRONMENTAL

S:\Jobs\Smoky\CERCLA\FS\FSTM2\Support\TimeSeries_updated20191211.xlsx



S:\GIS\arcprj2\010109\plt\FS\TechMemo2\Section3\Fig3-13_AG5.mxd

Legend

- Seep Locations
- Mine Pit
- Permeable Reactive Barrier

Notes:
1. Mine disturbance area boundary includes a 50-foot buffer.

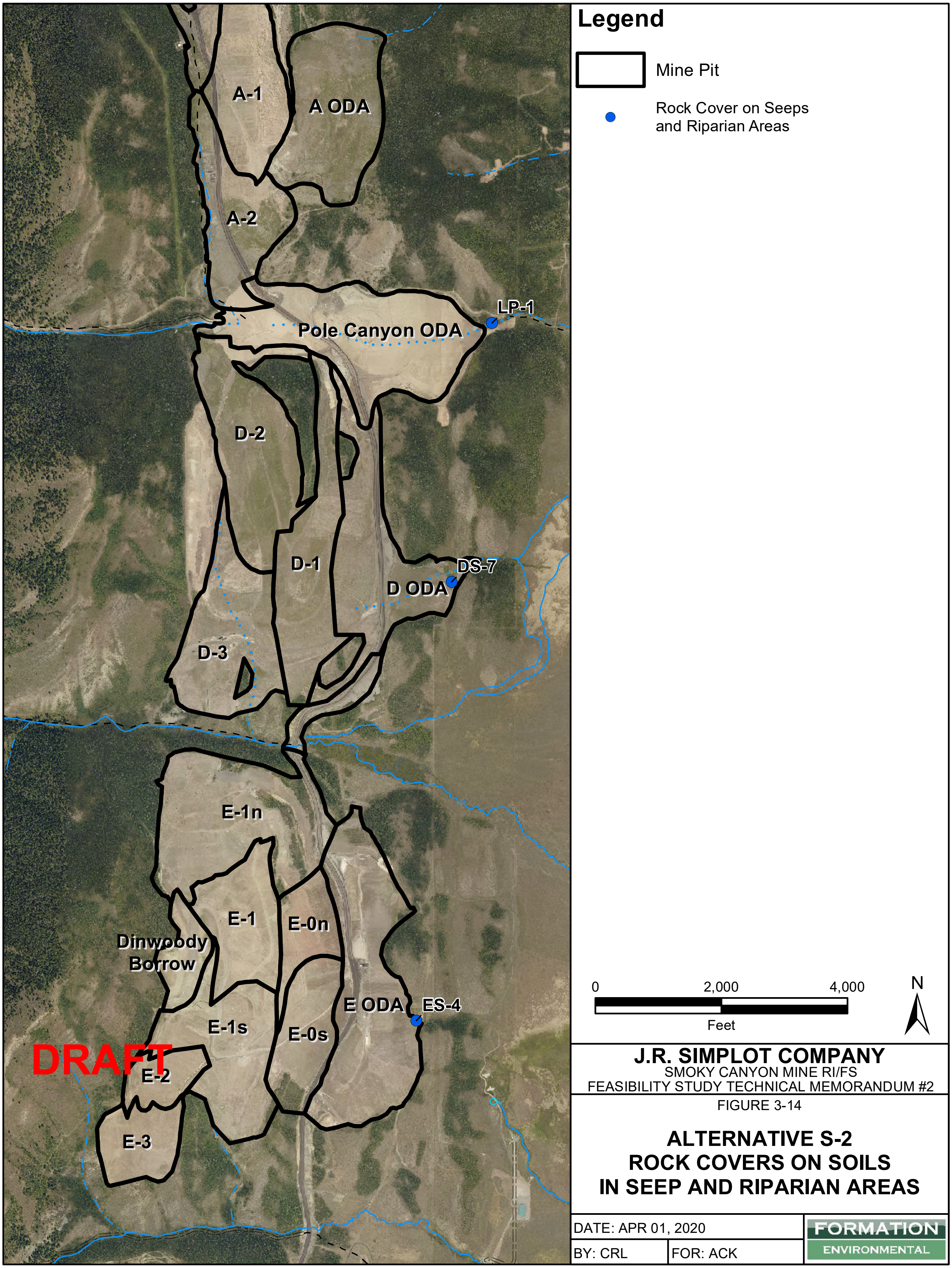
J.R. SIMPLOT COMPANY
SMOKY CANYON MINE RI/FS
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

FIGURE 3-13

ALTERNATIVE AG-5 PERMEABLE REACTIVE BARRIER AT LP-1 SEEP

DATE: APR 01, 2020
BY: CRL
FOR: ACK

FORMATION ENVIRONMENTAL



J.R. SIMPLOT COMPANY
SMOKY CANYON MINE RI/FS
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

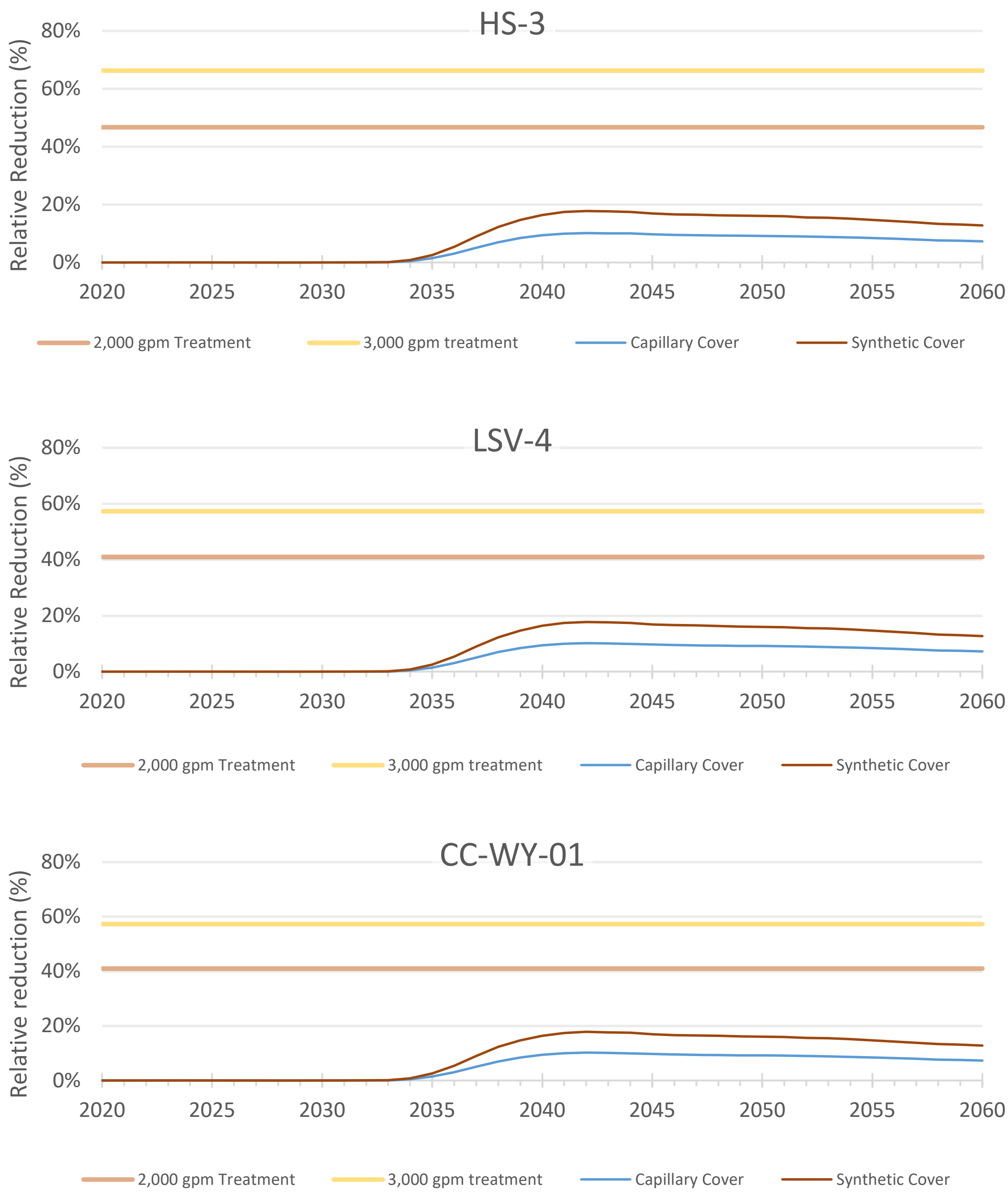
FIGURE 3-14

ALTERNATIVE S-2
ROCK COVERS ON SOILS
IN SEEP AND RIPARIAN AREAS

DATE: APR 01, 2020
BY: CRL
FOR: ACK

FORMATION ENVIRONMENTAL

S:\GIS\arcprj2\010109\plt\FS\TechMemo2\Section3\Fig3-14_S2.mxd



DRAFT

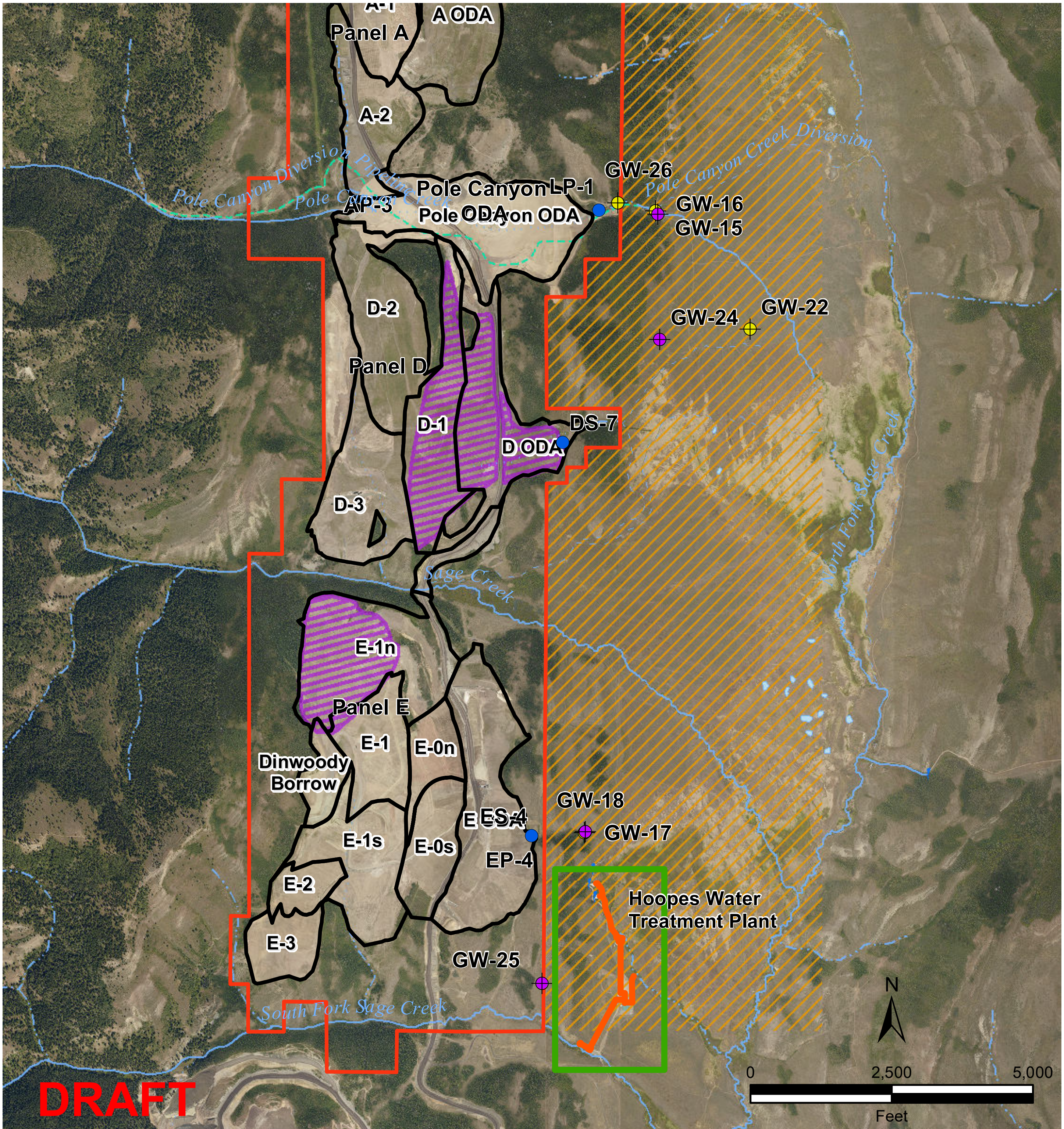
J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

FIGURE 4-1
MODEL ESTIMATED RELATIVE REDUCTION OF SELENIUM CONCENTRATIONS DOWNSTREAM OF HOOPES SPRING FOR SURFACE WATER ALTERNATIVES

DATE: APRIL 2020
BY: PHT
FOR: ACK

FORMATION ENVIRONMENTAL

S:\Jobs\Smoky\CERCLA\FS\FSTM2\Support\Surface Water Calcs_relativereduction20200323.xlsx Figs% Tab



Legend

- Rock Covers on Seeps/Ponds
- Effectiveness Groundwater Monitoring Location
- Effectiveness Groundwater Monitoring Location
- Water Treatment Plant Pipeline
- Deed_Restrictions
- Reclamation Cover Area (FS-2)
- Water Treatment Plant Area

J.R. SIMPLOT COMPANY

SMOKY CANYON MINE RI/FS
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

FIGURE 5-1

RECOMMENDED SITE-WIDE REMEDY

DATE: APR 01, 2020

BY: CRL | FOR: ACK

FORMATION ENVIRONMENTAL

S:\GIS\arcprj2\010109\plt\FS\TechMemo2\Section5\Fig5-01_RecommendedRemedy.mxd

APPENDIX A

MODEL DEVELOPMENT REPORT FOR WELLS FORMATION GROUNDWATER

DRAFT

APPENDIX A
Model Development Report for Wells Formation Groundwater

Prepared for:

J.R. Simplot Company
Smoky Canyon Mine
1890 Smoky Canyon Road
Afton, Wyoming 83110

TABLE OF CONTENTS

Tables

Figures

Attachments

LIST OF ABBREVIATIONS

CBL	Capillary Break Layer
CCBE	Cover with capillary barrier effect
EIS	Environmental Impact Statement
ET	Evapotranspiration
FS	Feasibility Study
GIS	Geographic Information System
HELP	Hydrologic Evaluation of Landfill Performance
in/yr	inches per year
MRL	Moisture Retention Layer
NEPA	National Environmental Policy Act
PV	Pore Volume
ODA	Overburden Disposal Area
RI	Remedial Investigation
ROM	Run-of-Mine

1 Introduction

The analytical model developed as part of the characterization of the fate and transport of selenium in Wells Formation groundwater at the Smoky Canyon Phosphate Mine (the Site) (see Figure A-1) for the Remedial Investigation (RI) (Formation 2014) was updated and used to evaluate the relative effectiveness of various remedial alternatives, both during the initial screening step and as part of the detailed analysis of alternatives for the Feasibility Study (FS). Updates to the RI analytical model and evaluation of remedial alternatives are described in this appendix; the reader is referred to Formation (2014, Appendix H) for additional discussion of the analytical model development.

1.1 Model Development Process

A collaborative model development process was followed during the development of the RI analytical model. A Model Development Group was led by Formation Environmental working on behalf of Simplot. Agency participants included representatives with IDEQ, BLM, EPA, and the Forest Service. A series of 14 web-based meetings were held from March 2012 through April 2013, and another 5 web-based meetings were held from November 2013 through April 2014. These Model Development Group meetings provided a forum for discussion of information regarding the development of the models. Participants identified model inputs and assumptions, appropriate approaches, and reviewed updates to the models. Each meeting built upon agreement and a common understanding established in previous meetings.

The model development process was guided by the work plan titled "Framework for Development of an Analytical Model for Wells Formation Groundwater" (Formation 2012). Model development was consistent with the principle of parsimony: Start simple and add complexity as warranted by the hydrogeology, transport processes, and the inability of the model to reproduce observations (after Hill, 1998). Model development progressed from water balance modeling previously performed for the Site (NewFields 2009a and 2009b), to a proof of concept spreadsheet model of groundwater transport to the Hoopes Spring and South Fork Sage springs, to the RI analytical model (Formation 2014, Appendix H).

More recently, Simplot organized a face to face meeting with the Agencies in December 2018 to discuss model status. Agency participants included representatives with IDEQ, BLM, EPA, and the Forest Service. An overview of the RI analytical model and model updates were discussed.

1.2 Purpose and Objectives

The updated RI analytical model (the "model") evaluates the relative effects of selenium sources on Wells Formation groundwater, which discharges at Hoopes Spring and South Fork Sage Creek springs (the "spring complex"). Source areas evaluated in the model are Panels A, B, C, D, and E (and associated external overburden disposal areas [ODAs]), and the Pole Canyon ODA. The model accounts for changes in contributions from these different source areas over time as mining and reclamation were implemented. The model provides a line of evidence in evaluation of the dynamic nature of varying historical Site conditions that have influenced selenium transport over time. Specific objectives of the model are:

- Identify the relative selenium contribution to the spring complex from each mine panel on a year by year basis and estimate the future contributions based on past, current, and future reclamation activities/removal actions

- Account for Site conditions that changed with time due to disturbance and reclamation history
- Support the evaluation of the relative effectiveness of remedial alternatives on resulting selenium concentrations and mass loading at the spring complex.

1.3 Report Organization

This document is organized in the following sections and attachments:

Section 1: Introduction

Section 2: Model Assumptions and Limitations

Section 3: Model Update Summary

Section 4: Results

Section 5: Evaluation of Remedial Alternatives

Section 6: Summary and Conclusions

Section 7: References

Attachment 1: Supplemental Analyses

Attachment 2: Mine Disturbance and Reclamation Maps.

2 Model Assumptions and Limitations

The model, developed to simulate the transport of selenium in the Wells Formation aquifer and discharge at the spring complex, is based on multiple simplifying assumptions. With these assumptions, it should be recognized that the model produces "relative" estimates of selenium loading contributions. Selenium loading assumptions (i.e., processes affecting mobilization and transport) from source areas were treated consistently between source areas. Therefore, evaluation of selenium loading to the spring complex should consider the simplifying assumptions relative to conditions unique to each source area. For example, potential differences in snow accumulation and infiltration of precipitation, degree of weathering in specific ODAs, thickness of specific ODAs, attenuation potential in the vadose zone (unsaturated Wells Formation and undisturbed colluvial/hillslope deposits), selenium transport times through the unsaturated zone, and discrete fractured zones in pit floors were not represented in the model but could affect the magnitudes and timing of selenium loads arriving and dissipating from the springs.

The following summarizes key model assumptions:

Equivalent porous media – Solute transport in Wells Formation groundwater is assumed to occur in a manner similar to transport in a porous medium. Multiple lines of evidence (see Formation 2014, Section 3.3) suggest the hydrostratigraphy of the Wells Formation does not meet this assumption. However, given the large distances and travel times from source areas to the spring complex a continuum approach to fluid flow (i.e., the fractured mass is hydraulically equivalent to a porous medium at the scale of interest) appears to be appropriate for approximating solute transport in the Wells Formation (USFS et al. 2011).

Conservative solute transport – Sorption and other reaction processes were assumed not to occur in the saturated Wells Formation. This assumption is consistent with detailed modeling analyses performed as part of the Environmental Impact Statements (EISs) for East Smoky (HGG 2018), Panels F and G (BLM and USFS 2007), and Panels B and C (BLM and USFS 2002).

*Net infiltration rates through covers are informed by Deep Dinwoody lysimeter observation*s – There is uncertainty with respect to net infiltration rates through the large-scale covers present at the Site. For example, unsaturated flow modeling estimated a long-term average net infiltration rate of 0.6 inches per year (in/yr) for the Deep Dinwoody cover (JBR 2007). The Deep Dinwoody cover at the limited scale of the lysimeter study, however, has exhibited net infiltration at 9 in/yr and greater for water years 2015 through 2018 (OKC 2019a). For this analysis, these observations are assumed to be representative for the Deep Dinwoody cover for conditions occurring during the observation period and at a large-scale and are used to inform the estimation of net percolation through reclamation covers at the Site (see Attachment 1 for additional discussion).

Steady-state groundwater flow – The model simulates an average, constant, groundwater flow system. In other words, seasonal gradient fluctuations are not represented. Given the large distances and travel times from source areas to the spring complex this approach is appropriate for approximating groundwater velocities in the Wells Formation. This simplifying assumption, however, can underestimate short-term groundwater flux and loading to the spring complex during periods of above average precipitation and hydrologic conditions.

Empirically-based, time-varying, selenium concentration function – The model simulates the change in selenium leached from seleniferous overburden sources to groundwater over time (the “source term”). This load of selenium to groundwater is estimated by the amount of water passing through the overburden each year and the chemistry of that infiltration. As described in the RI (Formation 2014, Section 3.5), the relative mix of distinct waste-rock lithologies in overburden influences the selenium concentrations as well as the potential for release of selenium. Historical mining and overburden disposal practices, however, did not include selective handling and disposal of lithologically distinct waste-rock materials. As a result, ODAs contain a heterogeneous and random mix of materials and thickness, referred to as run-of-mine (ROM) overburden. Therefore, the various mixtures present in the historical ODAs are considered to have essentially the same general geochemical characteristics and the same potential for release of selenium on a large-scale basis. This simplifying assumption results in adoption of a selenium source concentration function applied on a large-scale; unique source terms are applied to north-end source areas, south-end source areas, and the Pole Canyon ODA. Development of the source terms is consistent with National Environmental Policy Act (NEPA) modeling analyses (JBR 2007; BLM and USFS 2002) and Site-specific data from the column leach test for the Panels F and G EIS (JBR 2007). See section 4.2 and Attachment 1 for additional discussion.

Constant Overburden Thickness — ROM thickness varies substantially within a backfilled mine panel. For example, annual digital elevation models (available since 2003) of Panel E indicate a range of backfill thickness from less than 10 feet to over 300 feet, with an average of less than 100 feet. For modeling purposes, a constant thickness of 100 feet is assumed for Panels A, B, C, D, and E source areas; the assumed thickness of the Pole Canyon ODA is 200 feet. Overburden thickness is a variable in pore volume to time calculations for source term calculations (see section 4.2).

3 MODEL UPDATE SUMMARY

The following summarizes key model updates for the FS:

Life of Mine — Panel B is assumed to be reclaimed in year 2030, following the placement of overburden from the proposed East Smoky Panel Mine, with the currently approved topsoil and chert cover. The Industrial Well (GW-IW) is assumed to operate until 2033. Following the shutdown of GW-IW, groundwater within its capture zone (see Formation 2014, Appendix H Section 5.4.1.3) and associated selenium loading is assumed to flow south toward the spring complex.

Consistency with East Smoky EIS – Data and information from detailed groundwater flow and contaminant transport modeling analyses performed as part of the East Smoky EIS (HCG 2018) were integrated for consistency or used to verify the model, including:

- Groundwater flow conceptual model – The East Smoky EIS conceptualized Wells Formation groundwater to flow from north to south at the Site and to discharge at the spring complex. The model was revised for consistency. In other words, loading to groundwater associated with Panel A, B, and C source areas and subsequent transport is assumed to flow south unless captured by the Industrial Well (GW-IW).
- East Smoky EIS modeling (HCG 2018) simulated an approximate 30-year selenium transport time from north-end source areas to the spring complex. The model simulates a similar transport time from north-end source areas to the spring complex, verifying consistency of transport velocities with the East Smoky EIS modeling.
- The selenium source concentration for East Smoky Panel Mine overburden placed on Panel B is conservatively assumed to be consistent with the "north-end" concentration function developed in the RI modeling analyses (see Formation 2014, Appendix H, Section 5.4.1.1). This source concentration function results in a larger, more conservative, selenium concentration compared to source concentration estimates of East Smoky overburden, assuming either the Proposed Action or Reduced Pit Shell alternatives (see HCG 2018, Section 6.3).

Annual Distribution of Mine Disturbance and Reclamation Maps — A Geographic Information System (GIS) was used to develop gridded representations of annual disturbance areas, reclamation types, and backfill placement (see Formation 2014, Appendix H Section 5.2.1). These maps were updated (see Attachment 2) with information acquired since the RI (Formation 2014). Figure A-2 illustrates the disturbance areas and reclamation activities through year 2017. Attachment 2 provides a side-by-side comparison of the "Original Mine Disturbance and Reclamation Layers" (RI version) and "FS Mine Disturbance and Reclamation Layers" (updated version).

Existing Cover Performance – The Hydrologic Evaluation of Landfill Performance (HELP) model (Schroeder et. al. 1994) is used to estimate annual water balance components for covers (see Formation 2014, Appendix H, Section 5.2.2). These estimates are adjusted to reconcile HELP-estimated water-balance components (infiltration, runoff, and evapotranspiration [ET]) with Deep Dinwoody lysimeter observations (see Attachment 1).

Panel A Backfill — Annual mine operating reports (see Formation 2014, Appendix H, section 3.4) indicate overburden from Panels B and C were backfilled in Panel A after year 2001 (see Attachment 2); the north-end source term (see Formation 2014, Section 7.3.2.1) was defined for these areas in addition to sources areas in Panels B and C. Overburden placed in Panel A from 1984 through 2001 was defined with the *south-end source term*.

South-End Source Term — The source term was updated for consistency with methods used in NEPA modeling analyses (JBR 2007; BLM and USFS 2002), Site-specific column tests (JBR 2007), and revised net infiltration estimates. Section 4.2 and Attachment 1 provide additional discussion of source term development.

4 RESULTS

This section summarizes the results of modeling. Attachment 1, *Supplemental Analyses*, provides additional discussion.

4.1 INFILTRATION ESTIMATES FOR EXISTING COVERS AND UNCOVERED AREAS

Attachment 1 discusses the methodology used to estimate infiltration in existing covers and uncovered areas. Table A-1 summarizes the resulting estimates of long-term average infiltration. Table A-1 also provides a relative reduction for each cover type relative to an Exposed Overburden Pile (i.e., no cover).

4.2 SOUTH-END SOURCE TERM

The south-end source term is applied to infiltration resulting from incident precipitation on Panels D and E source areas; overburden placed in Panel A from 1984 through 2001 is also defined with the *south-end source term* because it was mined from Panel D. The source term is equivalent to the column leach test results for the "Panel F Backfill and External Fill" defined in the fate and transport modeling for the Panels F and G EIS (JBR 2007). Column leach tests provide concentrations per pore volume (PV). Thus, a PV to time conversion (see Formation 2014, Appendix H, Section 5.4.1.1), consistent with revised estimated infiltration rates, is necessary.

Figure A-3 illustrates the resulting south-end source term. The revised source term is based on a 6-in/yr infiltration rate, which results in a 30-year pore volume estimate. This rate is based on a calibration process that includes: 1) matching mass loading observations at the spring complex (section 4.4) and 2) approximating the characteristics of concentration observations at GW-25 (see Attachment 1).

Figure A-3 also illustrates a source term based on a 60-year pore volume estimate. This rate is applied to infiltration resulting from incident precipitation on the Pole Canyon ODA. This assumption is consistent with an assumed average overburden thickness of approximately 200 feet.

4.3 GROUNDWATER TRAVEL TIMES TO THE SPRING COMPLEX

Figure A-4 illustrates the travel times from source areas to the spring complex. The travel times in Figure A-4, summarized in a histogram by source area, highlight the overlapping character of the source areas without consideration of mine operation chronology. Travel times are based on estimated advective groundwater velocity and cell distance to the spring complex; not reflected in this presentation are the effects of dispersion, which can result in mass transport "behind" and "ahead" of the mean (i.e. advective) groundwater flow. Dispersion is, however, accounted for in the groundwater transport calculation (see Formation 2014, Appendix H, Section 5.3.1.2).

4.4 SELENIUM MASS LOADING AT THE SPRING COMPLEX

The calibration process, noted in section 4.2, incorporates the following general steps:

- *Estimate mass loading to the Wells Formation* — Loading to the Wells Formation is a function of infiltration and source concentration. Infiltration estimates are described in Attachment 1. The starting concentration of south-end sources (where time zero is the year backfilled is placed) is based on matching observed loading at the spring complex. Additionally, the source-term function is based on Site-specific column tests and a depletion rate conforming to NEPA modeling analyses. The depletion rate, however, is refined by the characteristics of selenium observations at GW-25 (see Attachment 1, *GW-25 Analysis*).
- *Selenium Transport to Spring Complex* (see Formation 2014, Appendix H, Section 5.3.1.2)
- *Summation of Model-Estimated Loading at Spring Complex* (see Formation 2014, Appendix H, Section 5.3.1.3)
- *Match of Estimated and Observed Mass Loading*—Annual observed mass loading at the spring complex are available for years 1984 to 1987 and years 1991 to 2019. Calculation of the observation data set is described in Formation 2014 (Appendix H, Section 5.3.1.3). Observations for years 2018 and 2019 are based on additional flow and concentration measurements (18 and 13, respectively); these estimates account for the effects of the Hoopes pilot treatment system (Formation 2019) and represent an estimate of the actual load discharging at the spring complex.

Figure A-5 and Figure A-6 present the results of the above process. Figure A-5 illustrates estimated infiltration on disturbed areas, estimated mass loading to the Wells Formation, and model-estimated mass loading to the spring complex for the period 1984–2025 (to highlight the calibration time-frame); estimated mass loading to the spring complex is also illustrated for the entire simulation period (1984–2060).

Figure A-6 illustrates the estimated selenium mass load to the Wells Formation and the estimated arrival at the spring complex for the entire model simulation time period (1984 through 2060). From Figure A-6, the relative timing of mine operations is apparent by comparison of loading to the Wells Formation. Earliest operations began at Panel A and Pole ODA in the mid-1980s, followed by Panel D, and finally Panel E. Figure A-6 also illustrates the lag time between loading in the Wells Formation to the estimated arrival at the spring complex. The mining sequence from north to south (see Attachment 2) combined with a southerly groundwater flow direction yields overlapping groundwater loading signatures. As shown in Figure A-6, loading associated with multiple panels and the Pole ODA generally arrive concurrently at the spring complex. These overlapping signatures result in a sharply increasing mass loading signature at the spring complex (Figure A-5). The contribution from the Pole Canyon ODA is estimated to continue increasing until approximately 2020 and to begin dissipating after 2028. Increases in loading at the spring complex from Pole Canyon ODA, however, have been offset by reductions associated with Panel E dissipation. Longer-term estimates of loading at the spring complex, as shown on Figure A-5, are dependent on dissipation of loading associated with Panels A and D but also on the depletion characteristics of the selenium source term function assumed by the model.

5 Evaluation of Remedial Alternatives

This section summarizes analyses in support of evaluation of remedial alternatives. Attachment 1, *Supplemental Analyses*, provides additional discussion.

An initial evaluation of remedial alternatives (see section 5.1) focuses on the relative infiltration reduction of four cover types evaluated, which are Synthetic, Enhanced Dinwoody, Capillary, and 5-Foot Dinwoody or Salt Lake Formation/Chert. Relative infiltration reduction is based on the percent reduction compared to an Exposed Overburden Pile (i.e., no cover).

A detailed evaluation of remedial alternatives (see section 5.2) focuses on two cover types: Synthetic and Capillary. Average yearly infiltration rates for each cover type are applied to target cover areas. Year 2022 is the assumed year of cover application on target areas.

5.1 Initial Evaluation—Relative Infiltration Reduction

Table A-2 summarizes estimated average yearly infiltration rates. Table A-2 also provides the infiltration reduction relative to an Exposed Overburden Pile (i.e., uncovered areas). The following summarizes the rationale for assumed infiltration rates for modeling in support of evaluation of remedial alternatives.

Synthetic — A cover system including a synthetic material was assumed to significantly reduce infiltration. For the purpose of modeling, an intact synthetic cover system is assumed with long-term infiltration at 0 in/yr.

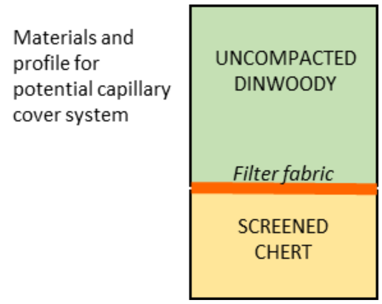
Enhanced Dinwoody — Geosyntec (2016) estimated a range of infiltration rates through the Enhanced Dinwoody material. The geometric mean[1] of the measured infiltration rates is 0.7 in/yr and is the assumed long-term average infiltration rate in model calculations.

Capillary — A cover with capillary barrier effect (CCBE) is designed to drain infiltrating water downslope to a point where it can be collected and removed, thus significantly reducing net percolation through the cover. The capillary barrier is created at the interface between the fine-textured layer (called the moisture retention layer, MRL) and the coarse-textured layer (called the capillary break layer, CBL) (Parent and Cabral 2006). Lateral flow occurs within the MRL along this interface as gravity-driven unsaturated drainage.

A capillary cover is considered in this analysis primarily due to lysimeter observations at the Blackfoot Bridge Mine “Simple 1” cover (Benson 2019). The Simple 1 cover (1.5 feet topsoil, 1.5 feet alluvium, and 2 feet chert) shows a significant portion of the water balance occurs as capillary driven lateral flow. For example, the lateral flow for calendar years 2016 through 2019 ranged from 21% to 43% of precipitation. Materials used in the Simple 1 cover construction, however, were not selected to achieve optimal capillary barrier effects. The chert material used in the construction of the Simple 1 cover was more coarse than normal (Benson, C.H. Teleconference. 31 January 2020), suggesting the chert may be acting as a CBL with the topsoil and alluvium acting as an MRL.

[1] Geotechnical variables with a wide variability are commonly represented with a lognormal distribution (USACE 2006).

A CCBE, consisting of uncompacted Dinwoody, root barrier/filter fabric, and screened chert with 150-foot drainage bench spacing is estimated to achieve a long-term annual average percolation rate of 5.7 inches (see Attachment 1, Figure A-A6[a]). These materials are selected based on their occurrence at the Site and ability to achieve capillary barrier effects. A discussion of CCBEs, including factors affecting the performance of CCBEs and the methodology for estimating infiltration rate is discussed in Attachment 1.



5-Foot Dinwoody or Salt Lake Formation/Chert Covers — The long-term average infiltration rate for this cover type is estimated to be 10.4 in/yr. This estimate is described further in Attachment 1.

5.2 Detailed Evaluation—Relative Mass Reduction at the Spring Complex

Simplot evaluated Site conditions and identified three areas that are primary candidates for covers: Panels D-1, and E-1n and the D Panel external ODA (Figure A-7). These areas are collectively termed “target cover areas.”

The detailed evaluation focuses on the relative mass reduction at the spring complex for two cover types: Synthetic and Capillary. Average yearly infiltration rates for these cover types are applied to target cover areas. Year 2022 is the assumed year of cover application on target areas.

Figure A-8 illustrates the relative mass reduction at the spring complex resulting from synthetic and capillary covers applied in year 2022 on target cover areas. Peak reduction for the synthetic and capillary covers is 17.8% and 10.2%.

6 Summary and Conclusions

The updated model evaluates the relative effects of selenium sources at Panels A, B, C, D, and E (and external ODAs), and the Pole Canyon ODA on Wells Formation groundwater, which discharges at the spring complex. The model accounts for changes in contributions from these different source areas over time as mining and reclamation were implemented. Specifically, the model identifies the relative selenium contribution to the spring complex from each mine panel on a year by year basis and estimates the future contributions based on past, current, and future reclamation activities/removal actions.

A summary of the modeling results includes the following:

- *Infiltration estimates* — Long-term average infiltration estimates were developed for existing covers and uncovered areas and range from a low of approximately 9 in/yr for a Deep Dinwoody cover to a high of about 15 in/yr for open mine pits and exposed overburden at ODAs.
- *South end source term* – The source term was estimated based on Site-specific column leach test results (30-year pore volume) and a 6-in/yr infiltration rate and was applied to infiltration resulting from incident precipitation on Panels D and E source areas and portions of Panels A.
- *Groundwater travel times* – Travel times from source areas to the spring complex were estimated based on advective groundwater velocity and distance to the spring complex.

- *Selenium mass loading* — Infiltration estimates, source concentrations, and estimates of travel time were used to estimate the selenium mass load to the Wells Formation and the estimated arrival at the spring complex for the model simulation time period (1984–2060).

Selenium mass load results account for Site conditions that change with time due to disturbance and reclamation history. The mining sequence from north to south combined with a southerly groundwater flow direction yields overlapping groundwater loading signatures. The mass load from the Pole Canyon ODA is estimated to continue increasing until approximately 2020 and to begin dissipating after 2028. Increases in loading at the spring complex from Pole Canyon ODA have been offset by reductions associated with Panel E dissipation. Longer-term estimates of loading at the spring complex are dependent on dissipation of loading associated with Panels A and D and on the depletion characteristics of the selenium source term.

The model results and supplemental analyses support the evaluation of the relative effectiveness of remedial alternatives on resulting selenium concentrations and mass loading at the spring complex.

The initial evaluation of remedial alternatives focuses on the estimated infiltration and relative infiltration reduction (relative to an Exposed Overburden Pile [i.e., uncovered areas]) of four cover types as follows:

- *Synthetic Covers* — Long-term average infiltration of 0 in/yr with a 100% infiltration reduction
- *Enhanced Dinwoody Covers* — Long-term average infiltration of 0.7 in/yr with a 95% infiltration reduction
- *Capillary Covers* — Long-term average infiltration of 5.7 in/yr with a 58% infiltration reduction
- *5-Foot Dinwoody or Salt Lake Formation/Chert Covers* — Long-term average infiltration of 10.4 in/yr with a 38% infiltration reduction.

After the initial screening, the detailed evaluation of remedial alternatives focuses on the average yearly infiltration rates applied to target cover areas to estimate the relative mass reduction at the spring complex for two cover types as follows:

- *Synthetic Covers* — Peak reduction is approximately 18%
- *Capillary Covers* — Peak reduction is approximately 10%.

Although the model identifies the relative selenium contribution to the spring complex from each mine panel on a year by year basis and estimates the future contributions based on past, current, and future reclamation activities/removal actions, it is important to recognize that the model produces “relative” estimates of selenium loading contributions and reductions. Evaluation of selenium loading to the spring complex by source area was based on several simplifying assumptions.

The initial screening of media-based remedial alternatives and the detailed and comparative analysis of remedial alternatives is presented in the main body of the FS Report. For additional discussion of development of the analytical model described in this appendix, the reader is referred to Formation (2014, Appendix H). For supplemental analyses of cover performance, infiltration estimates, the capillary cover, and selenium concentrations in well GW-25, the reader is referred to Attachment 1.

7 References

Albright W.H. and Benson C.H. 2017. Evaluation of the Water Balance of the Deep Dinwoody and Enhanced Dinwoody Test Sections at Smoky Canyon Mine. October 8.

American Geotechnics. 2016. Memorandum to Bill Stout, Bureau of Land Management, Pocatello, Idaho. Smoky Canyon Mine Caribou County, Idaho 2015 Annual Lysimeter Report Comments. February 25.

Benson, C.H. 2016. Hydraulic Conductivity Tests on Block Samples from Enhanced Dinwoody Layer – Smoky Canyon Mine. Letter to Rex Hansen, American Geotechnics, October 6.

Benson, C.H. 2019. Field Hydrology of the Simple 1 and GCLL Final Cover Test Sections for the East Overburden Pit and the North Pit, Blackfoot Bridge Mine: Annual Report for Calendar Year 2018. 10 May 2019.

Benson, C.H. Teleconference. 31 January 2020.

BLM and USFS. 2002. Bureau of Land Management and United States Forest Service. Final Supplemental Environmental Impact Statement (SEIS), Smoky Canyon Mine Panels B and C. Prepared by JBR Environmental Consultants, Inc., Sandy, UT. BLM, Pocatello Field Office, Pocatello, ID. USFS, Caribou-Targhee National Forest. April 2002.

BLM and USFS. 2007. Smoky Canyon Mine Panels F & G, Final Environmental Impact Statement. Prepared by JBR Environmental Consultants, Inc., Sandy, UT. Caribou-Targhee National Forest and BLM Idaho State Office. October 2007.

Formation Environmental, LLC. 2012. Framework for Development of an Analytical Model for Wells Formation Groundwater. Prepared for The J.R. Simplot Company. March.

Formation Environmental LLC (Formation). 2014. Final Smoky Canyon Mine Remedial Investigation/Feasibility Study Remedial Investigation Report. Prepared for J.R. Simplot Company, Afton, Wyoming and Boise, Idaho. September.

Formation. 2019. July 2019 Groundwater and Surface Water Monitoring Study Field-Scale Permeable Reactive Barrier Pilot Study. Conda/Woodall Mountain Mine. Prepared for J.R. Simplot Company. September.

Geosyntec. 2016. Cover Percolation Calculations: Panel F Enhanced Dinwoody Cover System, Smoky Canyon Mine, Eastern Caribou County, Idaho. December 1.

Hill, M.C., 1998. Methods and Guidelines for Effective Model Calibration: U.S Geological Survey Water - Resources Investigations Report 98-4005, 90p.

HydroGeoGroup, LLC (HGG). 2017. Memorandum to Brian Buck, Stantec, Sandy, Utah. East Smoky Groundwater Modeling Report East Smoky Panel, Smoky Canyon Mine – Caribou Country, Idaho. September 29.

HGG. 2018. Final Technical Memorandum East Smoky Panel of the Smoky Canyon Mine Numerical Modeling Report. March.

JBR Environmental Consultants, Inc. (JBR), 2007. Groundwater Flow and Solute Transport Modeling Report, Smoky Canyon Mine, Panels F and G Extension Area.

NewFields, 2009a. DRAFT Overview Of The Smoky Canyon Mine Analytical Model, January 21, 2009, Prepared for The J.R. Simplot Company.

NewFields, 2009b. DRAFT Smoky Canyon Mine Analytical Model Revisions and Modifications, May 12, 2009, Letter to Ms. Mary Kauffman, USDA Forest Service, Idaho Falls, ID.

OKC. 2015. O'Kane Consultants USA. Smoky Canyon Mine "F" and "G" Panels Expansion Deep Dinwoody Cover System Field Performance Trial 2015 Annual Performance Monitoring Report. Prepared for J.R. Simplot. Anaconda, Montana. December 14.

OKC. 2017. O'Kane Consultants USA. Smoky Canyon Mine "F" and "G" Panels Expansion Deep Dinwoody Cover System Field Performance Trial 2016 Annual Performance Monitoring Report. Prepared for J.R. Simplot. Anaconda, Montana. January 19.

OKC. 2018. O'Kane Consultants USA. Smoky Canyon Mine "F" and "G" Panels Expansion Deep Dinwoody Cover System Field Performance Trial 2017 Annual Performance Monitoring Report. Prepared for J.R. Simplot. Anaconda, Montana. January 30.

OKC. 2019a. O'Kane Consultants USA. Smoky Canyon Mine "F" and "G" Panels Expansion Deep Dinwoody Cover System Field Performance Trial 2018 Annual Performance Monitoring Report. Prepared for J.R. Simplot. Anaconda, Montana. January 16.

OKC. 2019b. O'Kane Consultants USA. Smoky Canyon Mine "F" and "G" Panels Expansion Deep Dinwoody Cover System Field Performance Trial 2019 Annual Performance Report. Prepared for J.R. Simplot. Saskatoon, Saskatchewan, CA. December 31.

Parent, S.E. and A.R. Cabral. 2006. Design of inclined covers with capillary barrier effect. Geotechnical and Geological Engineering Journal, 24:689-710.

Schroeder, P.R., T.S. Dozier, P.A. Zappi, B.M. McEnroe, J.W. Sjostrom, and R.L. Peyton. 1994. The Hydrologic Evaluation of Landfill Performance (HELP3) Model: Engineering Documentation for Version 3. EPA/600/R-94/168b. U.S. Environmental Protection Agency Office of Research and Development, Washington, D.C. September.

U.S. Army Corps of Engineers (USACE). 2006. "Reliability Analysis and Risk Assessment for Seepage and Slope Stability Failure Modes for Embankment Dams", Engineer Technical Letter 1110-2-561, Washington, D.C.

USFS et al. 2011. Evaluation of the Transport and Persistence of Selenium in Wells Formation Groundwater at the Smoky Canyon Mine. Provided to J.R. Simplot Company with Agency Comments (dated October 7, 2011) on the Draft 2010 Annual Effectiveness Monitoring Report for the Pole Canyon Removal Action (dated August 19, 2011).

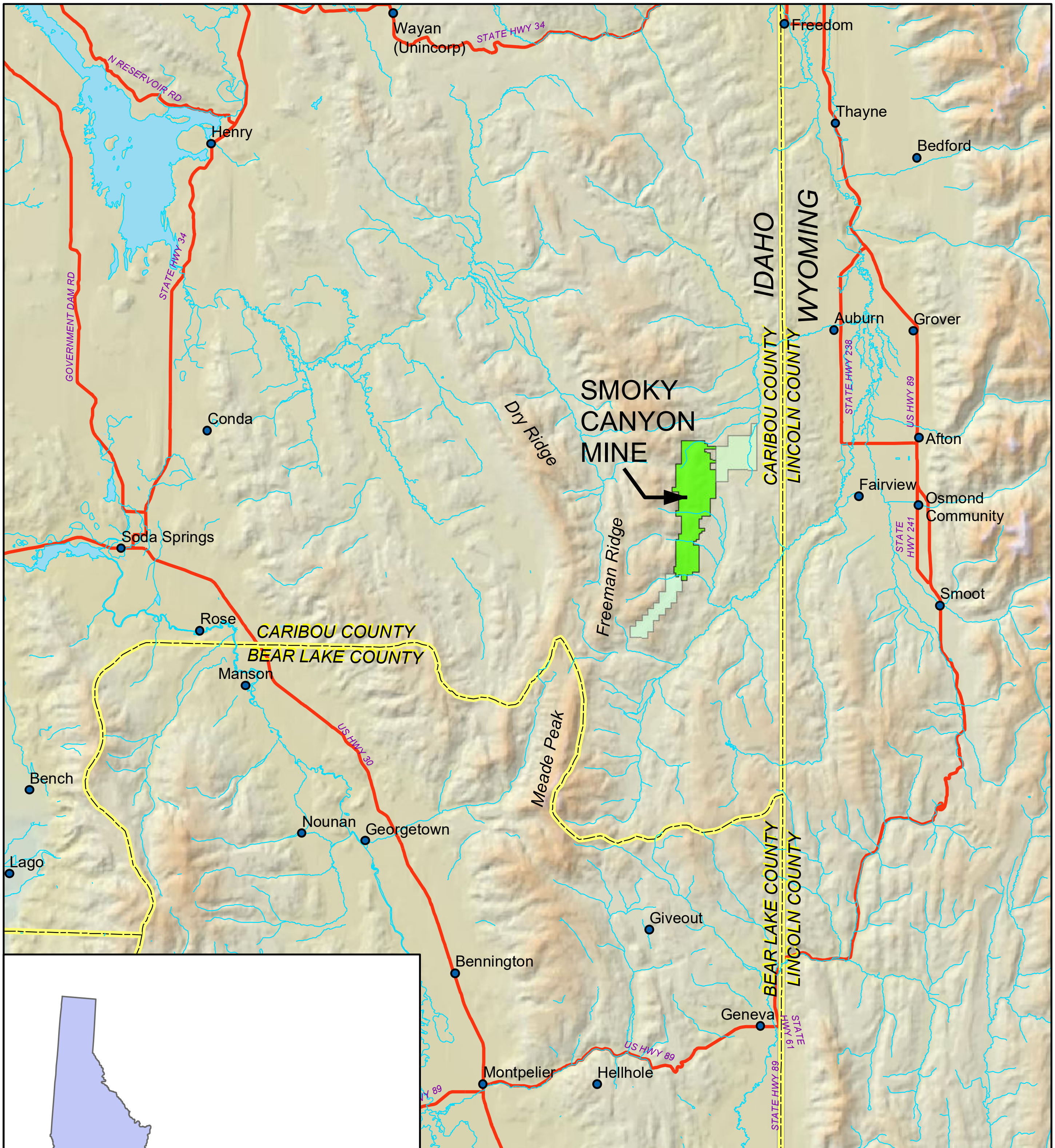
TABLE A-1. ESTIMATED LONG-TERM AVERAGE INFILTRATION FOR EXISTING COVERS AND UNCOVERED AREAS.

Cover Type	Long-Term Average Percolation	Infiltration Reduction Relative to Exposed Overburden Pile
	in/yr	%
EXISTING COVERS		
Deep Dinwoody Cover	9.2	37%
5-Foot Dinwoody or Salt Lake Formation/Chert Covers	10.4	29%
Panel E Cover	11.0	25%
Panels B and C Cover	12.8	12%
Old Topsoil Chert Cover	13.1	10%
Thin Topsoil Cover	13.5	7%
UNCOVERED AREAS		
Exposed Overburden Pile	14.6	0%
Open Mine Pit	15.2	--

TABLE A-2. ESTIMATED LONG-TERM AVERAGE INFILTRATION FOR COVERS USED IN REMEDIAL ALTERNATIVE EVALUATION

Cover Type	Long-Term Average Percolation	Infiltration Reduction Relative to Exposed Overburden Pile[1]
	in/yr	Percent
Synthetic	0	100%
Enhanced Dinwoody	0.7	95%
Capillary	5.7	58%
5-Foot Dinwoody or Salt Lake Formation/Chert Covers	10.4	38%

[1] Estimated average infiltration rate for the Exposed Overburden Pile is 14.6 in/yr.



J.R. SIMPLOT COMPANY
SMOKY CANYON MINE RI/FS
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

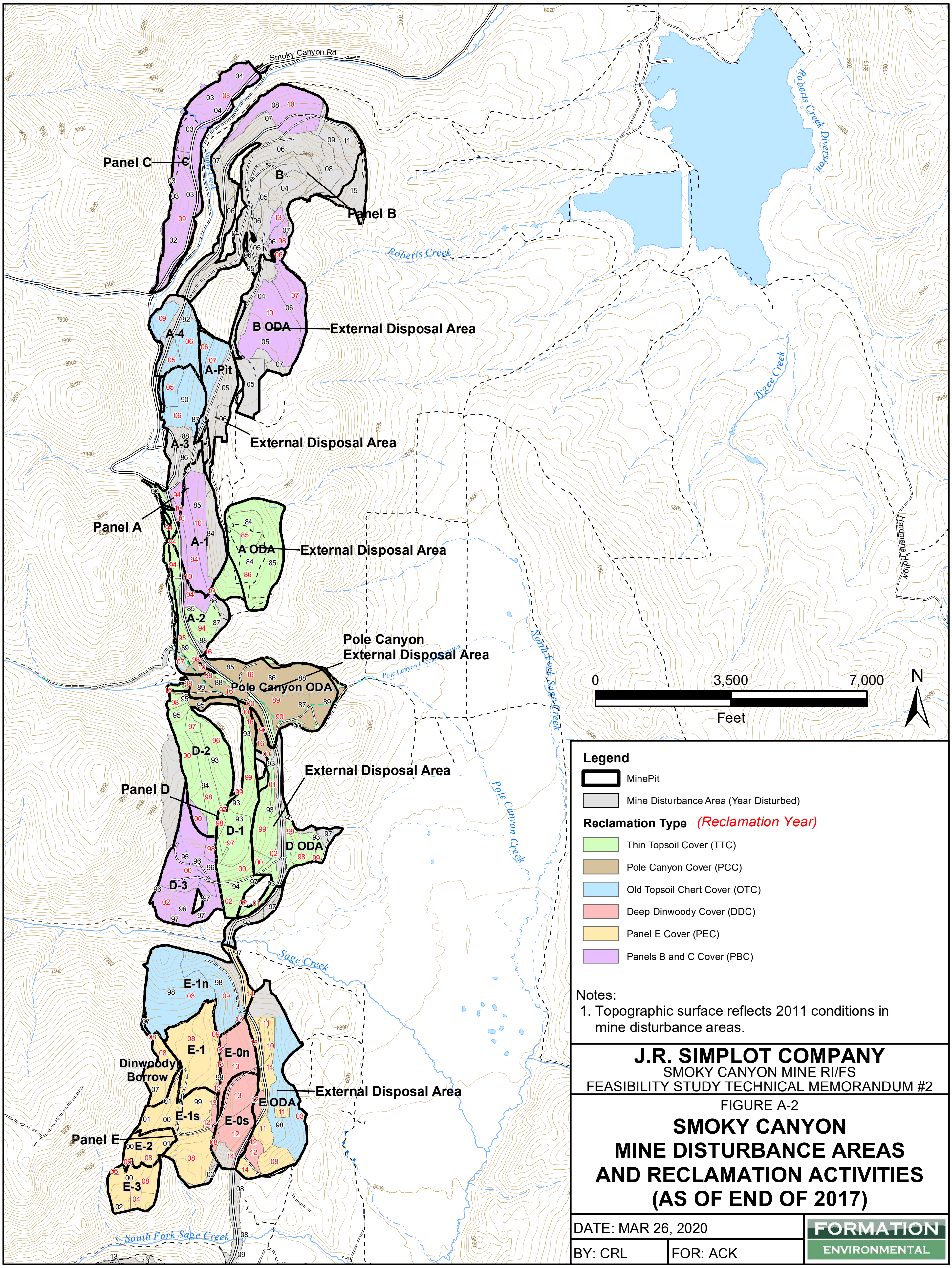
FIGURE A-1

LOCATION OF THE SMOKY CANYON MINE

DATE: MAR 26, 2020
BY: CRL
FOR: ACK

FORMATION ENVIRONMENTAL

S:\GIS\arcprj2\010109\plt\FS\TechMemo2\AppendixA\AppA_Fig01_RgnLoc.mxd



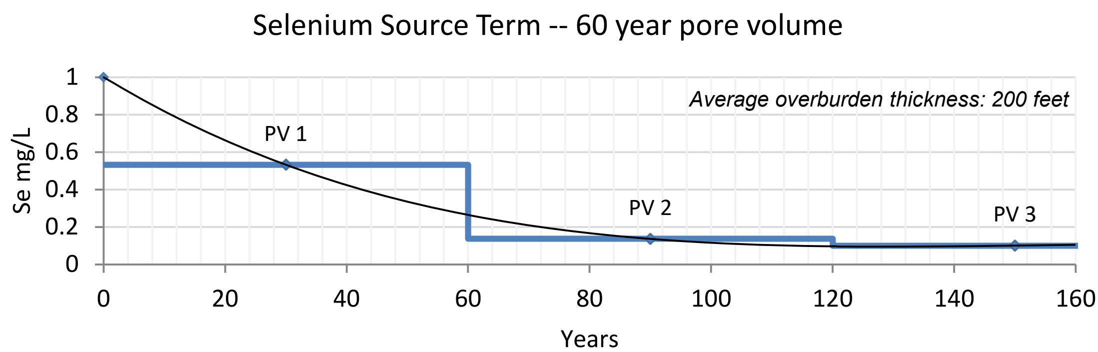
J.R. SIMPLOT COMPANY
SMOKY CANYON MINE RI/FS
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

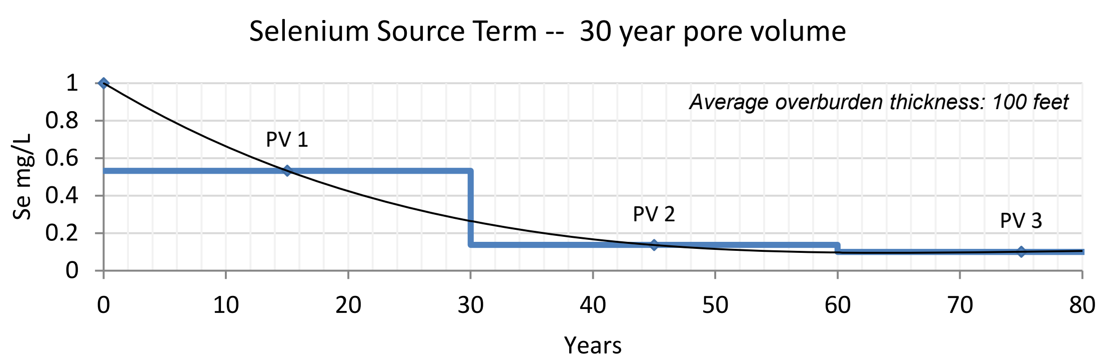
FIGURE A-2

SMOKY CANYON MINE DISTURBANCE AREAS AND RECLAMATION ACTIVITIES (AS OF END OF 2017)

DATE: MAR 26, 2020
BY: CRL
FOR: ACK

FORMATION ENVIRONMENTAL





PV	*Panel F Backfill and External Fill (mg/L)*
1	*0.532*
2	*0.136*
3	*0.1*
5	*0.055*
7	*0.059*
9	*0.046*
10	*0.08*

Notes:

Pore volume (PV) to time conversion is based on time for one pore volume to infiltrate through overburden:

$$\frac{Overburden\ Thickness \ * \ \ Porosity\ contributing\ to\ flow}{Annual\ Infiltration\ Rate}$$

Average thickness = 100 and 200 ft
Porosity contributing to flow = 0.15
Infiltration rate = 6 inches per year

PV concentrations based on "Panel F Backfill and External Fill" column leach tests (JBR 2007).

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

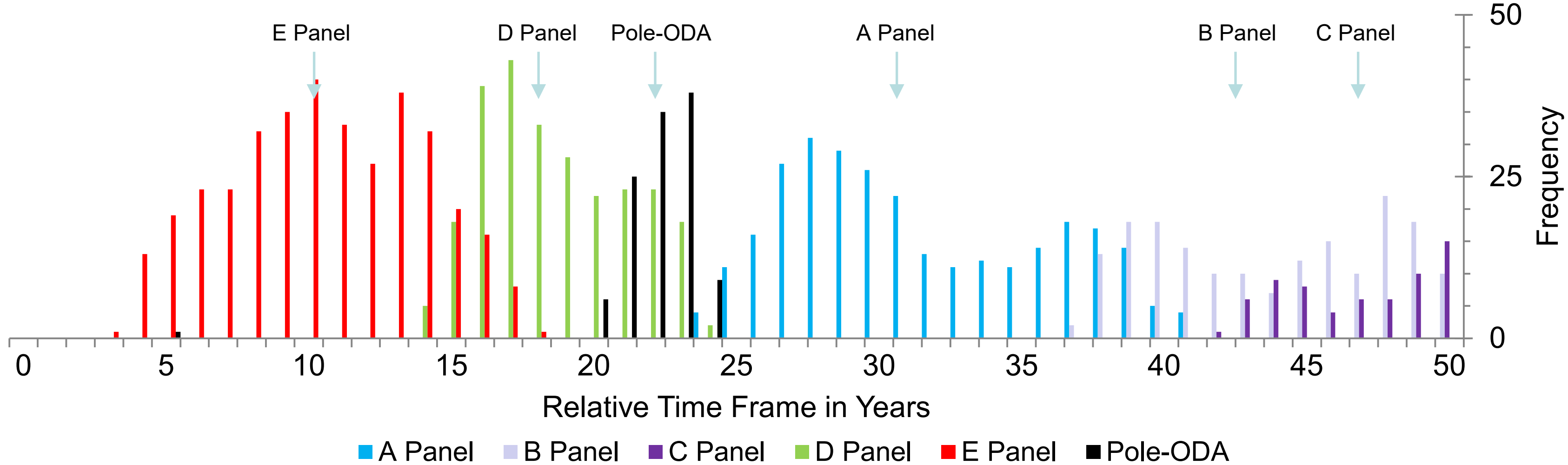
FIGURE A-3

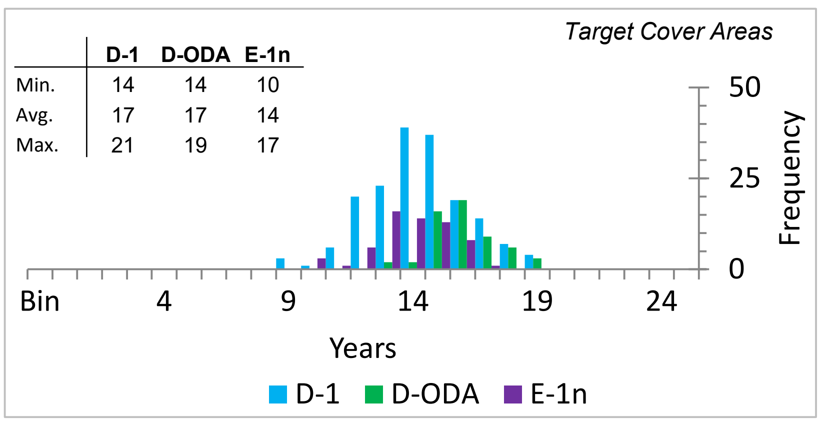
SOUTH-END SELENIUM SOURCE TERM

DATE: MARCH 2020
BY: PHT
FOR: ACK

FORMATION ENVIRONMENTAL

S:\Jobs\Smoky\CERCLA\FS\Model\GW_rev2019\SrcTerm_GW25.xlsx





	D-1	D-ODA	E-1n
Min.	14	14	10
Avg.	17	17	14
Max.	21	19	17

DRAFT

Notes:
- Travel time is based on advective groundwater velocity and cell distance to the springs complex.
- Frequency is based on acre grid-cells with seleniferous material.

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

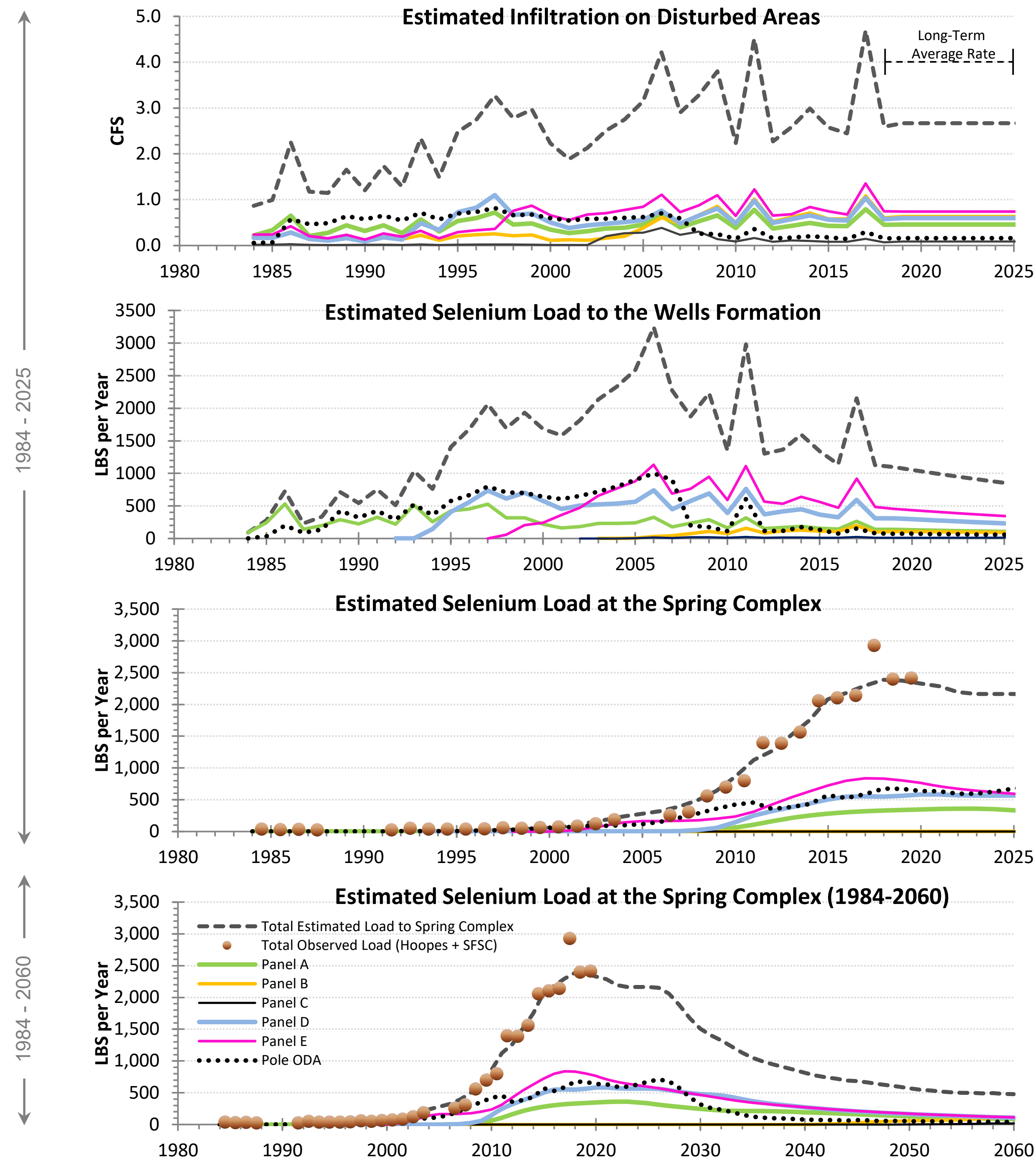
FIGURE A-4

HISTOGRAM OF ESTIMATED TRAVEL TIMES FROM SOURCE AREAS TO THE SPRING COMPLEX

DATE: MARCH 2020
BY: LJM
FOR: AKC

FORMATION ENVIRONMENTAL

S:\Jobs\Smoky\CERCLA\FS\FSTM2\AppxA-GW\TravelTime_histograms.xlsx



Notes:

CFS = cubic feet per second
LBS = pounds

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

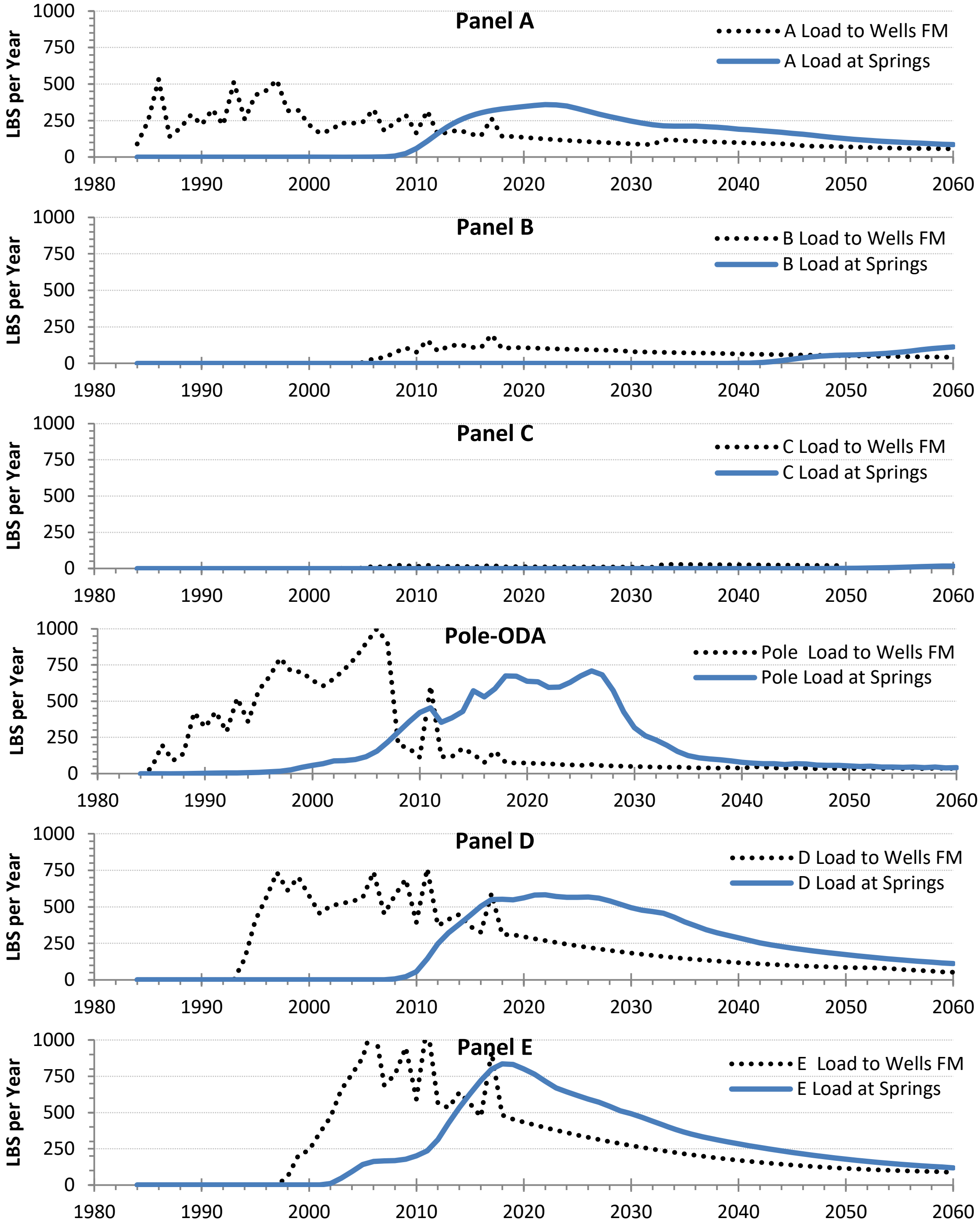
FIGURE A-5

ESTIMATED INFILTRATION ON DISTURBED AREAS, SELENIUM LOADING TO THE WELLS FORMATION AND TO THE SPRING COMPLEX

DATE: MARCH 2020
BY: PHT
FOR: ACK

FORMATION ENVIRONMENTAL

S:\Jobs\Smoky\CERCLA\FS\Model\GW_rev2019\FS_Model_revB16in_BASE.xlsx



Notes:

LBS = Pounds

DRAFT

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

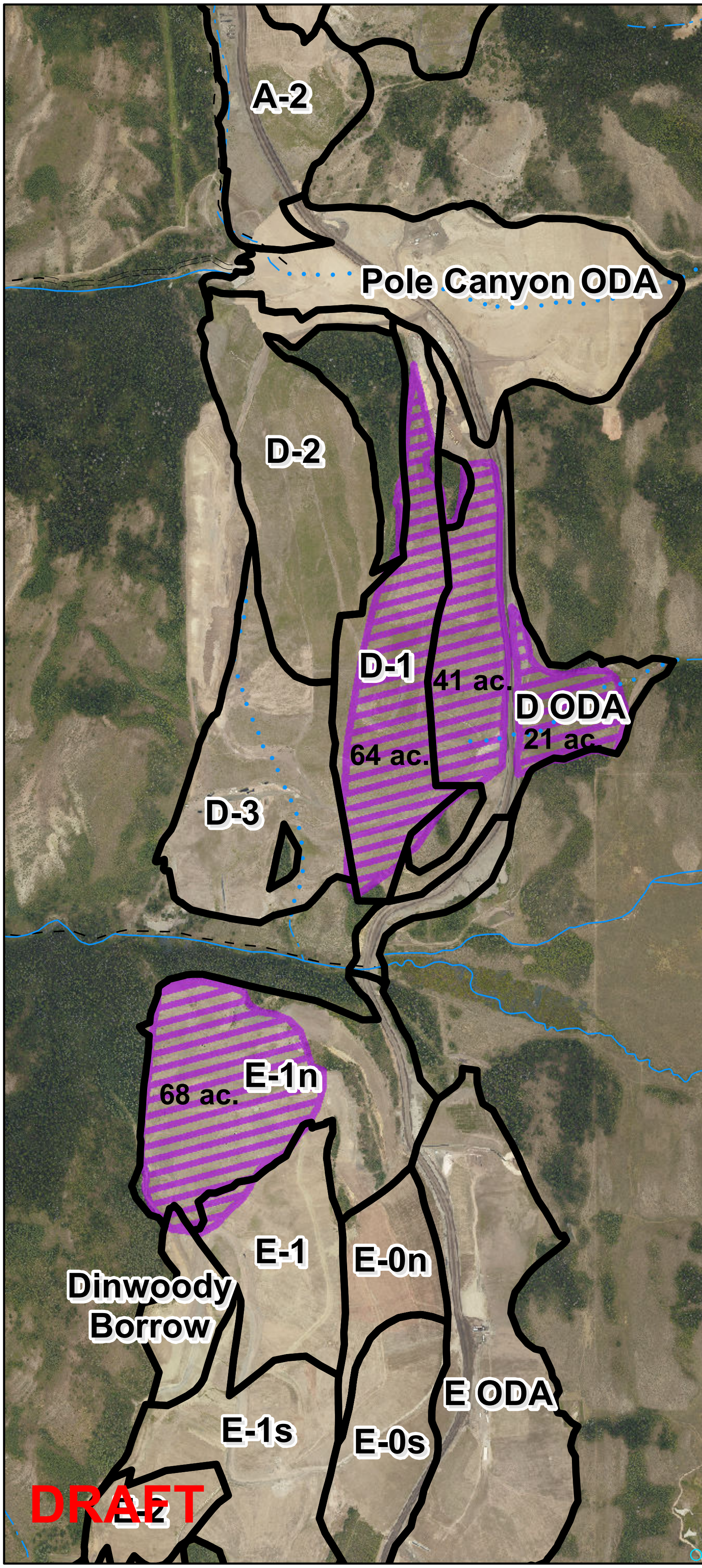
FIGURE A-6

ESTIMATED SELENIUM MASS LOAD TO THE WELLS FORMATION AND ARRIVAL AT SPRING COMPLEX FOR EACH SOURCE AREA

DATE: MARCH 2020	
BY: PHT	FOR: ACK

FORMATION ENVIRONMENTAL

S:\Jobs\Smoky\CERCLA\FS\Model\GW_rev2019\FS_Model_revB16in_BASE.xlsx



Legend

Mine Pit

Reclamation Cover Area (FS-2)

0 1,500 3,000
Feet

N

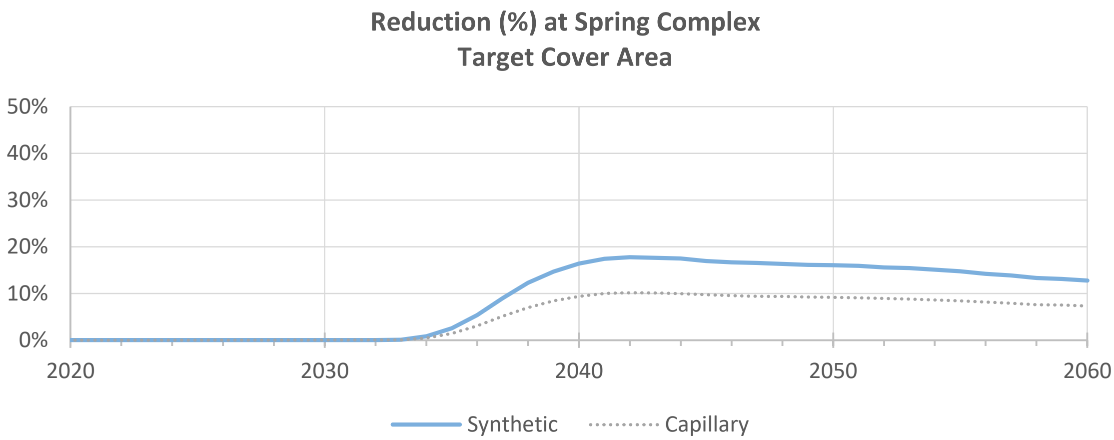
J.R. SIMPLOT COMPANY
SMOKY CANYON MINE RI/FS
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

FIGURE A-7

TARGET COVER AREAS OF PANELS D AND E FOR FS COVERS

DATE: MAR 26, 2020		FORMATION ENVIRONMENTAL
BY: CRL	FOR: ACK	

S:\GIS\arcprj2\010109\plt\FS\TechMemo2\AppendixA\AppA_Fig07_Uncovered_DE_FS.mxd



	Maximum Reduction (%)	Year of Peak Reduction	Year First Reduction
Synthetic	17.8	2042	2035
Capillary	10.2	2042	2035

DRAFT

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

FIGURE A-8
MODEL ESTIMATED RELATIVE MASS REDUCTION AT SPRING COMPLEX

DATE: MARCH 2020
BY: PHT
FOR: ACK

FORMATION ENVIRONMENTAL

S:\Jobs\Smoky\CERCLA\FS\Model\GW_rev2019\FS_Model_revB\Relative_REVb_0320_6in.xlsx

DRAFT

APPENDIX A – ATTACHMENT 1
Supplemental Analyses

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

AWHC	Available Water Holding Capacity
CBL	Capillary Break Layer
CCBE	Cover with capillary barrier effect
cm/s	centimeters per second
DAF	Dilution Attenuation Factor
DDC	Deep Dinwoody cover
EIS	Environmental Impact Statement
EOP	Exposed Overburden Pile
ET	Evapotranspiration
ft	foot
HELP	Hydrologic Evaluation of Landfill Performance
in/yr	Inches per year
k-function	Hydrologic conductivity function
L	Diversion length
m	meters
m/m	meters per meter
m/yr	meters per year
mg/L	milligrams per liter
mm/cm	millimeter per centimeter
MRL	Moisture Retention Layer
OMP	Open Mine Pit
PV	Pore Volume
Q_{max}	Diversion capacity
q	Percolation rate
RI/FS	Remedial Investigation/Feasibility Study
yr	year

1 Introduction

This document is Attachment 1 to Appendix A of the Smoky Canyon Mine Remedial Investigation/Feasibility Study (RI/FS), Feasibility Study Technical Memorandum #2: Development, Screening, and Detailed Analysis of Remedial Alternatives.

This Attachment provides details of supplemental analyses performed in support of model development and evaluation of remedial alternatives. Supplemental analyses include the following:

- Cover Performance — Includes infiltrations estimates for existing covers, uncovered areas, and capillary covers
- GW-25 Analysis — Describes of the evaluation of the south-end source term relative to the characteristics of concentrations in groundwater at GW-25.

2 Cover Performance

2.1 Infiltration Estimates for Existing Covers and Uncovered Areas

The Hydrologic Evaluation of Landfill Performance (HELP) model (Schroeder et. al. 1994) is used to estimate annual (water year) water balance components for covers (see Formation 2014, Appendix H, Section 5.2.2). Water balance components include infiltration (or percolation), runoff, evapotranspiration (ET), and change in storage. Based on comparison to the Deep Dinwoody lysimeter observations (OKC 2019a), however, HELP generally overpredicts ET and runoff, and underpredicts percolation. An adjustment process is used to reconcile HELP-estimated water-balance components with Deep Dinwoody lysimeter observations. The methodology assumes the fraction of annual ET and runoff that is overpredicted is available for percolation. The adjustment process entails the following steps:

Step 1: Adjust Estimated Water Balance for Deep Dinwoody Cover (DDC) – HELP estimates of ET, runoff, and percolation are adjusted to best match lysimeter observations as follows: First, HELP-estimated ET is adjusted to lysimeter observations for water years 2015–2018 (see Figure A-A1). A downward adjustment of 12.6% minimizes errors (root mean square and mean average error) between observation and adjusted ET values; the adjustment fraction is applied to percolation. Second, a fraction of HELP-estimated runoff is applied to percolation; the fraction is selected to minimize runoff and percolation errors between observation and adjusted values (see Figure A-A1). The adjustment fractions from the above steps are applied for all HELP-estimated water balance components for the model simulation period (1984–2060). The adjustment process results in a long-term average for ET, runoff, and percolation of 12.6, 2.3, and 9.2 inches per year (in/yr), respectively, for the DDC. As illustrated in Figure A-A1, reasonable estimates of percolation are achieved compared to lysimeter observations over the applicable observation period (2015–2018)[1].

Step 2: Adjust Estimated Water Balance for Other Cover Types – HELP estimates of ET, runoff, and percolation are adjusted for the remaining cover types as follows: HELP-estimated ET for each cover type is assumed to be overestimated by the same fraction estimated for the Deep Dinwoody cover (12.6%,

[1] OKC (2019a) indicates the Deep Dinwoody cover evolved due to a drying and wetting processes, resulting in an increase of hydraulic conductivity from 1e-6 to 2e-5 centimeters per second (cm/s) of the lower Dinwoody layer. As a result, water year 2014 is assumed to be non-representative of the evolved cover characteristics and is excluded in the adjustment process.

step 1); the adjustment fraction for each cover type is applied to percolation. Second, available water holding capacity (AWHC) is estimated for the fine-grained fraction of each cover. The relationship of 1 millimeter per centimeter (mm/cm) (OKC 2017, Appendix L) is assumed for topsoil and Dinwoody. Table A-A1 lists the assumed average thickness of fines and estimated AWHC for each cover type. For each cover, the difference of AWHC compared to the DDC is assumed to be percolation; the average long-term percolation for each cover is the sum of the DDC cover percolation rate (9.2 inches) and the AWHC difference. A runoff adjustment factor is applied to HELP-estimated runoff for each cover to approximate the estimated average long-term percolation rate. The above steps are applied for HELP-estimated water balance components for the model simulation period (1984–2060). Table A-A2 summarizes the resulting adjusted water balance components for all cover types.

Step 3: Adjust Estimated Water Balance for Uncovered Areas – HELP estimates of ET, runoff, and percolation are adjusted for uncovered areas as follows: HELP-estimated ET for uncovered areas is assumed to be overestimated by the same fraction estimated for the Deep Dinwoody cover (12.6%, step 1); the adjustment fraction for each area is applied to percolation. Uncovered areas include exposed overburden piles and open mine pits. The open mine pit is internally drained and, therefore, has no runoff adjustment. Runoff from exposed overburden piles is assumed to be a small fraction of precipitation; 1.5% of precipitation is assumed. Table A-A3 lists adjusted water balance components for covered areas for the period of 1984 through 2060.

2.2 Capillary Cover

2.2.1 Background

A cover with capillary barrier effect (CCBE) is designed to drain infiltrating water downslope to a point where it can be collected and removed, thus significantly reducing net percolation (or infiltration) through the cover. The capillary barrier is created at the interface between the fine-textured layer (called the moisture retention layer, MRL) and the coarse-textured layer (called the capillary break layer, CBL) (Parent and Cabral 2006). Lateral flow occurs within the MRL along this interface as gravity-driven unsaturated drainage.

The capacity of a CCBE to divert water is a function of the hydraulic conductivity of the MRL and the slope of the fine/coarse interface. The MRL retains infiltrating water by capillary forces while still conducting the flow of water under unsaturated conditions (Morris and Stormont 1999). At a theoretical point downslope, capillary forces no longer hold the water in the MRL, and breakthrough occurs. Breakthrough is defined as the point along the capillary barrier interface where the matric suction in the fine layer becomes equal to the water entry pressure of the coarse layer (Pease and Stormont 1996). The *diversion length* is the horizontal distance from the top of the slope to the breakthrough point.

Design of a CCBE requires an assumption of an *allowable percolation* rate. The allowable percolation rate is assumed to be equivalent to the expected long-term annual average infiltration rate that would occur in the cover constructed without lateral flow diversions (i.e., drainage benches). In an inclined CCBE, this infiltration rate occurs downslope at a distant equivalent to the diversion length. Placement of drainage benches at or downslope of the diversion length (where the allowable percolation rate occurs) reduces the effective percolation rate over that distance. The *effective percolation* rate is defined as the integrated rate of percolation through the cover over a horizontal distance.

Figure A-A2 illustrates (a) water balance schematic of a CCBE and (b) water flow vectors related to lateral diversion within the cover. Lab experiments and modeling studies have shown breakthrough occurs progressively along the sloped interface (Parent and Cabral 2006). This concept of partial breakthrough is adopted in calculations to evaluate an uncompacted Dinwoody over screened chert cover (Section 2.2.4). Downslope of the diversion length, percolation through the cover is assumed to be equal to the long-term annual average infiltration rate.

The diversion length is directly proportional to the diversion capacity of the cover, or the maximum flow that a capillary barrier can divert. Diversion capacity depends on the unsaturated hydraulic conductivity functions (k-functions) of the MRL and CBL materials, as well as the fine-textured layer thickness and slope angle (Vachon et al. 2015). Figure A-A3 illustrates (a) typical k-functions of soil, sand, and gravel; and (b) k-functions of typical materials and relationship for estimating CCBE performance. As shown in Figure A-A3, the hydraulic conductivity of the finer-textured layer is orders of magnitude greater than that of the coarser-textured layer for a range of drainable, plant-available suctions. A capillary break forms at relatively low matric suction values where the k-function curves cross. Diversion capacity is proportional to the area under the MRL k-function curve for a given allowable percolation rate, as shown in Figure A-A3.

Evaluation of the k-functions for material combinations at the Site (see OKC 2015) indicates that a compacted Dinwoody placed over weathered chert would not likely produce capillary barrier effects under realistic infiltration rates (see Figure A-A4). This is consistent with topsoil and Dinwoody *interflow* observed in the Deep Dinwoody lysimeter (OKC 2019a) where these water balance components are typically 1–2% of precipitation. Conversely, the combination of an uncompacted Dinwoody placed over screened chert (the *Dinwoody capillary cover*, hereafter) indicates potential for a CCBE (see Figure A-A4).

2.2.2 Purpose

As discussed above, the combination of uncompacted Dinwoody (functioning as an MRL) and the screened chert (functioning as a CBL) indicates CCBE potential. The Dinwoody capillary cover is evaluated further using Site-specific data with techniques presented in Parent and Cabral (2006); these techniques were amended to estimate an *effective percolation* rate through the cover for a range of distances between drainage benches.

2.2.3 Estimating Diversion Length

OKC (2015) reported estimated k-functions for uncompacted Dinwoody and screened chert; these functions were digitized[2] for use in this evaluation and are illustrated in Figure A-A5(a). Diversion capacity and diversion length are estimated for a range of Dinwoody layer thicknesses and allowable percolation rates. A 3H:1V slope is assumed in this analysis (shallower slope angles have smaller diversion capacities and shorter diversion lengths; described further in Section 2.2.6). As a simplification of the relationship presented in Parent and Cabral (2006), breakthrough occurs progressively, but the diversion length is assumed to be the distance at which the percolation rate equals the allowable average long-term infiltration rate, as shown in Figure A-A5(b).

Equation 1 shows the relationship between diversion capacity (Q_{max}), diversion length (L), and allowable percolation rate (q). Diversion capacity is calculated for a given allowable percolation rate.

[2] using the software program, Engauge Digitizer (Mitchell et al. 2020)

$$L = \frac{Q_{max}}{q} \tag{1}$$

Q_{max} is proportional to the area under the MRL k-function curve for a given allowable percolation rate. The basic form of this relationship is illustrated in Equation 2. As shown in Equation 2, Q_{max} is also proportional to the tangent of the slope angle, ϕ.

$$Q_{max} = k_{sat} tan\phi \int_{\psi_{c\_CBL}}^{\psi_{c\_MRL}} k_r(\Psi) d\Psi \tag{2}$$

where k_{sat} is the saturated hydraulic conductivity and $k_r(\Psi)$ is the relative k-function.

Parent and Cabral (2006) provide techniques to optimize cover material thicknesses. This allows evaluation of diversion lengths for varying material thicknesses. For conditions evaluated in this analysis, diversion capacity becomes Equation 3. The integral represents the area under the curve of the MRL k-function between two defined suction limits.

$$Q_{max} = tan\phi \int_{\psi_{c\_CBL}}^{th_{MRL} \times \gamma_w + \psi_{c\_CBL}} k(\Psi) d\Psi \tag{3}$$

where th_{MRL} is the thickness of the MRL and γ_w is the unit weight of water. For more information on the limits of the integral and the derivation of this method, see Parent and Cabral (2006).

2.2.4 Estimating Effective Percolation

The following describes the method to estimate the effective percolation rate with varying drainage bench spacing along the slope. First, because diversion length is defined as a horizontal distance, the theoretical bench spacing (minus an assumed 20-foot [ft] width of plastic) was trigonometrically converted to a horizontal distance for comparison. If the horizontal drainage bench spacing is less than the diversion length for a given allowable percolation rate, breakthrough has not yet occurred over that distance. Modeling by Parent and Cabral (2006) show the percolation rate through the interface at breakthrough is related to the infiltration rate through the top of the cover as follows:

$$q_i = 0.998q^{1.024} \tag{4}$$

Equation 4 estimates the percolation rate through the capillary barrier up to the breakthrough point. If the diversion length, L, is greater than the drainage bench spacing, L_{bench}, breakthrough has not occurred. Conversely, if the bench spacing is longer, breakthrough does occur and percolation through the cover equals infiltration into the top. Based on the simplified method presented in Figure A-A5(b), flow through the capillary interface along the slope was estimated both before and after breakthrough, and converted to an effective percolation rate, q_{eff} (Equations 5 and 6):

$$q_{eff} = \frac{0.5 \times q_i \times L_{bench}}{L} \quad \text{for } L_{bench} \leq L \tag{5}$$

$$q_{eff} = \frac{0.5 \times q_i \times L + q \times (L_{bench} - L)}{L_{bench}} \text{ for } L_{bench} > L \tag{6}$$

2.2.5 Results

The diversion capacity of the Dinwoody capillary cover is calculated assuming a 3H:1V slope and a Dinwoody layer thickness of 2 feet. Given these parameters, the diversion capacity and diversion length are estimated for a range of allowable percolation rates: 5 in/yr, 7.5 in/yr, 10 in/yr, and 12 in/yr.

Effective percolation is estimated at intervals representing different spacing of drainage benches along a 1,000-ft, 3H:1V slope for the range of allowable percolation rates (5 in/yr, 7.5 in/yr, 10 in/yr, and 12 in/yr). A percent reduction in percolation is also calculated for each interval. Figure A-A6 presents (a) the effective percolation with drainage bench spacing and (b) the estimated percent reduction in percolation.

The optimal bench spacing for the Dinwoody capillary cover is estimated based on the approximate breakthrough point (i.e., diversion length) for each allowable percolation rate (Figure A-A6). Table A-A4 shows the optimal bench spacing and resulting effective percolation rates. Results of the analysis indicate that placement of drainage benches at the optimal interval along the 3H:1V slope reduces percolation by approximately 67%.

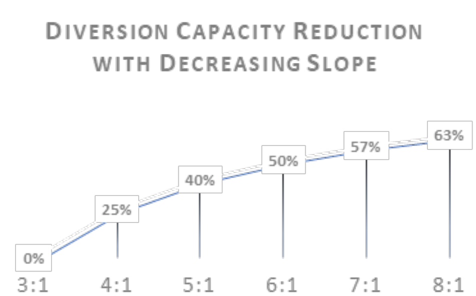
The Dinwoody over chert cover (see Table A-A1) has a similar profile to the Dinwoody capillary cover. Thus, a long-term average infiltration rate of approximately 10 in/yr is expected. As shown in Figure A-A6(a), a 5.7 in/yr effective percolation rate is assumed in modeling analyses (Appendix A) evaluating the Dinwoody capillary cover.

2.2.6 Discussion

Based on the analysis of diversion length and effective percolation, the two most important factors in the Dinwoody capillary cover performance are slope angle and material properties. These parameters and additional assumptions applied in the analysis are discussed below.

<u>Slope angle</u>

Slope angle is an important factor in the performance of a CCBE. As noted in Equation 2, the diversion capacity is proportional to the tangent of the slope. In other words, a steeper slope results in a greater diversion capacity and longer diversion length.[3] Decreasing the slope from 3H:1V to 4H:1V, for example, results in a 25% reduction in diversion capacity and a shorter diversion length. Finally, given a fixed drainage bench spacing, a shallower slope results in higher effective percolation rates.



<u>Materials Properties</u>

The soil-water characteristic curve and grain-size distribution of the two materials comprising the MRL and CBL play a critical role in the k-functions used to estimate diversion length. For this analysis, k-

[3] Diversion length is proportional to diversion capacity (see equation 1).

functions of the Dinwoody and chert as defined by OKC (2015) are used. Key characteristics of these materials are noted below:

- Uncompacted Dinwoody: based on available information of Site materials, the uncompacted Dinwoody provides the best "compromise between strong capillarity and high hydraulic conductivity" (Parent and Cabral, 2006) as the MRL.
- Screened Chert: Screening the chert material for the CBL is important because removing fines allows the layer to drain freely and maintain a very low hydraulic conductivity in unsaturated conditions.

By comparison, the diversion length and effective percolation were estimated for a cover consisting of compacted Dinwoody over weathered chert. Assuming the same slope and thickness, this combination of materials was ineffective as a CCBE. This is consistent with negligible interflow observations at the Deep Dinwoody lysimeter OKC (2019b), which was constructed with compacted Dinwoody and unscreened chert. The combination of cover materials produces a minimal capillary barrier effect (i.e., short diversion length with most infiltration resulting in net percolation over the length of the lysimeter).

<u>Material Thickness</u>

Parent and Cabral (2006) provide techniques to optimize cover material thicknesses. Diversion lengths were evaluated for increasing thicknesses of uncompacted Dinwoody over the screened chert. The comparison showed that the increase in cover performance was negligible for thicknesses greater than two feet. Therefore, 2-feet is assumed the optimal uncompacted Dinwoody thickness.

The screened chert layer thickness was assumed to be a minor factor. Although methods exist to optimize the thickness of the CBL, Parent and Cabral (2006) indicate that when a CBL material is coarser than the underlying material (i.e., overburden), the CBL thickness would not be a limiting factor. That is, construction considerations would likely require an adequate thickness to achieve CBL effects.

<u>Effective Percolation</u>

An important assumption regarding the effective percolation calculation is that the relationship between long-term infiltration (allowable percolation) and percolation across the MRL/CBL interface with distance downslope was derived empirically by Parent and Cabral (2006). Equation 4 is based on curve-fitting methods for the set of materials and slope angles modeled in their study. Therefore, this exact relationship may not apply to the Dinwoody capillary cover.

However, the effective percolation estimates presented for the Dinwoody capillary cover are likely conservative. First, Vachon et al. (2015) concluded that the Parent and Cabral (2006) analytical method predicts a conservative diversion length, based on comparison with transient simulations and field data. A conservative (slightly shorter) diversion length, with a given spacing of drainage benches, leads to a somewhat higher (more conservative) effective percolation rate. Second, the simplified method used to calculate effective percolation with distance downslope (see Figure A-A5[b]) is conservative because it assumes the maximum percolation rate occurs starting at the diversion length. Instead, downward flow into the CBL occurs gradually and reaches a maximum downslope of the diversion length calculated with the analytical method. Assuming the maximum rate over this distance slightly overestimates effective percolation.

3 GW-25 Analysis

The selenium concentrations in groundwater at GW-25, downgradient of Panel E, are evaluated with a simple groundwater mixing analysis. The analysis assumes an average aquifer flux (average aquifer parameters and gradient) mixed with a mass load from percolation through overburden, with an approximated south-end source term (*source term*). The following text describes the source term and the groundwater mixing analysis.

Source Term

The source term is an empirically-based time-varying selenium concentration function and is based on Site-specific column tests of "Panel F Backfill and External Fill" overburden material (JBR 2007). Column leach tests are conducted as sequential cycles followed by drainage. The cycles are related to volumes of water equivalent to the pore volume (PV) of the solid samples in the columns. Concentration (milligrams per liter [mg/L]) per pore volume (PV) is the result.

Material Source	Se (mg/L), PV 1 2 3 5 7 9 10
Panel F Backfill and External Fill (JBR 2007)	0.532, 0.136, 0.1, 0.055, 0.059, 0.046, 0.08

Relating the PV concentrations to application in the model requires a PV to time conversion. The conversion estimates the time calculated for a PV of recharge water from precipitation and snow melt to transit the pit backfills (Stantec 2017). Time for one pore volume to transit through overburden is Equation 7:

$$\frac{Overburden\ Thickness\ *\ Porosity\ contributing\ to\ flow}{Annual\ Infiltration\ Rate} \tag{7}$$

Overburden thickness varies substantially within a backfilled mine panel. For example, annual digital elevation models (available since 2003) of Panel E indicate a range of backfill thickness from less than 10 feet to over 300 feet, with an average of less than 100 feet. For modeling purposes, a constant thickness of 100 feet is assumed for Panels A, B, C, D, and E source areas; the assumed thickness of the Pole Canyon ODA is 200 feet. Following the convention established by the BLM and Forest Service for the Dairy Syncline project (BLM and USFS 2019), it is assumed that approximately 15% of the total backfill volume at the field scale will support unsaturated water flow and be subject to leaching (Stantec 2017).

Based on estimated annual infiltration rates through covers (Table A-A2), the calculated times for the PVs to transit the pit backfill range from 13 to 20 years. As noted in Appendix A, estimation of the source term included 1) matching mass loading observations at the spring complex (Appendix A, section 4.4) and 2) matching the characteristics of concentration observations at GW-25. A simple groundwater mixing analysis is used evaluate source term depletion rates and is discussed further below.

Groundwater Mixing Analysis

EPA (EPA 1996ab) describes a *Dilution Factor Model*, which can account for the adsorption, attenuation, and mixing of leachate with clean groundwater in an aquifer. The evaluation presented herein assumes no attenuation or degradation; only dilution of leachate from overburden with clean groundwater is considered. EPA (1996b) expresses this reduction in concentration with a dilution attenuation factor (DAF), which is defined as the ratio of soil (i.e., overburden) leachate concentration to a concentration in groundwater (i.e., a location downgradient of the source area). The lowest possible DAF is 1, which corresponds to the situation where there is no dilution (or attenuation) of a contaminant (i.e., when the concentration in the groundwater is equal to the leachate concentration) (EPA 1996b).

A simple mixing zone equation derived from a water-balance relationship (Equation 8) is used to calculate the site-specific DAF. Mixing-zone depth, d_a, is estimated from Equation 9. Mixing zone depth cannot exceed aquifer thickness. In other words, when mixing-zone depth is estimated to be larger than aquifer thickness, the aquifer thickness becomes the upper limit of the mixing zone depth.

The analysis assumes Panel E is the source area and GW-25 is the observation location downgradient of the source. The site-specific DAF, from Equations 8 and 9, is applied to multiple source terms (based on varying annual infiltration rates). The results are compared to concentrations at GW-25. Observed concentrations at GW-25 are plotted on a relative timescale, normalized to year 2011 (arrival of selenium plume in groundwater).

$$DAF = 1 + \frac{Kid}{IL} \qquad (8)$$

$$= (0.0112 \cdot L^2)^{0.5} + d_a \left\{1 - exp\left[\frac{-LI}{Kid_a}\right]\right\} \qquad (8)$$

where:

- K = Aquifer hydraulic conductivity (meters per year [m/yr])
- I = Hydraulic gradient (meters per meter [m/m])
- d = Mixing zone depth (meter [m]). A calculated mixing zone depth can exceed the aquifer thickness (da). In this case, da is used for mixing zone depth.
- I = Infiltration rate (m/yr)
- L = Source length parallel to groundwater flow (m)
- d_a = Aquifer thickness (m).

The analysis assumes an average aquifer flux (average aquifer parameters and gradient). The hydraulic conductivity, *K*, value assumed is 300 m/yr (2.7 ft/day), the calibrated Upper Wells Formation *K* from HGG (2016, 2018). The gradient, *i*, assumed is 0.0048 (m/m). This value is based on the long-term (2008–2019) average gradient observed between GW-18 and HS-SP08, which is assumed the most representative of conditions in the Panel E vicinity. The source length parallel to groundwater flow, *L*, is 1,220 m (4,000 ft), which is based on the distribution of seleniferous overburden (Attachment 2) and interpreted potentiometric maps (e.g., Formation 2014, Appendix H, Figure H.3-10). The maximum mixing zone depth is 152 m (500 ft) an assumed practical mixing depth limit.

Figure A-A7 illustrates the estimated groundwater concentrations at GW-25 based on 30-year (yr) and 60-yr calculated times for the PVs to transit the pit backfill. The 30-yr case represents an infiltration rate of 6 in/yr. This source term is assumed to be representative of south-end source areas. The 30-yr case is compared to a linear regression of observed selenium concentrations at GW-25, which is comparable to the depletion rate. The 60-yr case is used to represent the source term on the Pole Canyon overburden disposal area (ODA), which has an assumed thickness of 200-ft, and is shown here for illustrative purposes.

Discussion

Use of GW-25 observations for comparison in the mixing model analysis assumes the well is constructed and sampled consistent with assumptions in mixing model analysis. Figure A-A8 and Figure A-A9 are provided to support this assessment. Figure A-A8 illustrates water level observations relative to the screen interval, water producing zone during drilling, first water during drilling, and sampling location. As shown in Figure A-A8, the well is generally screened across the water table and is screened across the water-producing intervals encountered during drilling. The sampling port is also located within the water producing intervals. Figure A-A9 provides the boring log and well completion information.

In addition to the well construction information, the estimated mixing zone depth from the analysis should be considered. For the cases considered, the estimated mixing zone depth is substantially greater than the screened interval length of GW-25. In other words, long-term observations at GW-25 should be informative to evaluation of source depletion rates of Panel E sources.

4 REFERENCES

American Geotechnics. 2016. Memorandum to Bill Stout, Bureau of Land Management, Pocatello, Idaho. Smoky Canyon Mine Caribou County, Idaho 2015 Annual Lysimeter Report Comments. February 25.

BLM and USFS. 2019. Bureau of Land Management and United States Forest Service. Final Environmental Impact Statement, Proposed Dairy Syncline Mine and Reclamation Plan. Prepared by Stantec Consulting Services Inc., Salt Lake City, UT. BLM, Pocatello Field Office, Pocatello, ID. USFS, Caribou-Targhee National Forest. November 2019.

U.S. EPA. 1996a. Soil Screening Guidance: Technical Background Document, EPA/540/R-95/128, May 1996.

U.S. EPA. 1996b. Soil Screening Guidance: Fact Sheet. Publication 9355.4-14FSA; EPA/540/F-95/041; PB96-963501. July 1996.

Formation. 2014. Formation Environmental LLC. Final Smoky Canyon Mine Remedial Investigation/ Feasibility Study Remedial Investigation Report. Prepared for J.R. Simplot Company, Afton, Wyoming and Boise, Idaho. September.

Mitchell, M., Muftakhidinov, B., and Winchen, T., et al, "Engauge Digitizer Software." Webpage: http://markummitchell.github.io/engauge-digitizer, Last Accessed: March 17, 2020.

Morris C. E. and Stormont J. C. 1999. Parametric study of unsaturated drainage layers in a capillary barrier. Journal of Geotechnical and Geoenvironmental Engineering, 125: 1057-1065.

HGG. 2016. Technical Memorandum East Smoky Panel of the Smoky Canyon Mine Numerical Model Development & Calibration. November.

HGG. 2018. HydroGeo Group, LLC. Final Technical Memorandum East Smoky Panel of the Smoky Canyon Mine Numerical Modeling Report. March.

JBR Environmental Consultants, Inc. (JBR), 2007. Groundwater Flow and Solute Transport Modeling Report, Smoky Canyon Mine, Panels F and G Extension Area.

OKC. 2015. O'Kane Consultants USA. Memorandum: Modeling Performance of Current and Enhanced Cover System Designs based on Preliminary Field Response Modeling Inputs.

OKC. 2017. O'Kane Consultants USA. Smoky Canyon Mine "F" and "G" Panels Expansion Deep Dinwoody Cover System Field Performance Trial 2016 Annual Performance Monitoring Report. Prepared for J.R. Simplot. Anaconda, Montana. January 19.

OKC. 2019a. O'Kane Consultants USA. Smoky Canyon Mine "F" and "G" Panels Expansion Deep Dinwoody Cover System Field Performance Trial 2018 Annual Performance Monitoring Report. Prepared for J.R. Simplot. Anaconda, Montana. January 16.

O'Kane. 2019b. Smoky Canyon Mine "F" and "G" Panels Expansion Deep Dinwoody Cover System Field Performance Trial 2019 Annual Performance Report. Prepared for J.R. Simplot. Saskatoon, Saskatchewan, CA. December 31.

Parent S-É. and Cabral A.R. 2006. Design of inclined covers with capillary barrier effect. Geotechnical and Geological Engineering Journal, 24: 689-710. doi: 10.1007/s10706-005-3229-9.

Pease, R.E. and Stormont J.C. 1996. Increasing the diversion length of capillary barriers. In: Joint Conference on the Environment, Albuquerque, New Mexico.

Schroeder, P.R., T.S. Dozier, P.A. Zappi, B.M. McEnroe, J.W. Sjostrom, and R.L. Peyton. 1994. The Hydrologic Evaluation of Landfill Performance (HELP3) Model: Engineering Documentation for Version 3. EPA/600/R-94/168b. U.S. Environmental Protection Agency Office of Research and Development, Washington, D.C. September.

Stantec. 2017. Source Term for the East Smoky Panel EIS Fate and Transport Modeling. Memo from Brian Buck (Stantec) to Kyle Free (BLM) dated September 7, 2017.

Vachon B. L., Abdolahzadeh, A. M., and Cabral A. R. 2015. Predicting the diversion length of capillary barriers using steady state and transient state numerical modeling: case study of the Saint-Tit-des-Caps landfill final cover. Canadian Geotechnical Journal, 52: 2141-2148. doi:10.1139/cgj-2014-0353.

TABLE A-A1. CURRENT COVER TYPES, MATERIAL PROFILES, ESTIMATED WATER HOLDING CAPACITIES, AND ESTIMATED LONG-TERM AVERAGE PERCOLATION

Cover Type	Cover Description	Assumed Thickness of Fines	Estimated AWHC[1]	Average Adjusted Percolation 1984-2018
		feet	inches	inches
Deep Dinwoody Cover	Top soil (1 ft), Dinwoody (3 ft), Chert (2 ft)	4	4.8	9.2
5-Foot Dinwoody or Salt Lake Formation/Chert Covers	Dinwoody (3 ft), Chert (2 ft)	3	3.6	10.4
Panel E Cover	Topsoil (0.5 ft), Dinwoody (2 ft), Chert (2 ft)	2.5	3.0	11.0
Panels B and C Cover	Topsoil (1 ft), Chert (4 ft)	1	1.2	12.8
Old Topsoil Chert Cover	Topsoil (0.5-1.0 ft), Chert (4-10 ft)	0.75	0.9	13.1
Thin Topsoil Cover	Topsoil (0.5-1.0 ft), No Chert	0.75	0.5	13.5

[1] Estimated available water holding capacity of fines is based on 1 mm/cm (OKC 2017, Appendix L; American Geotechnics 2016.)

TABLE A-A2. ADJUSTED AVERAGE WATER BALANCE COMPONENTS (1984–2060) FOR COVERED AREAS

Cover Type	ET	Runoff	Percolation	Percolation
	% of precipitation			Inches
Deep Dinwoody Cover	53%	9%	38%	9.2
5-Foot Dinwoody or Salt Lake Formation/Chert Covers	50%	7%	43%	10.4
Panel E Cover	50%	5%	46%	11.0
Panels B and C Cover	45%	2%	53%	12.8
Old Topsoil Chert Cover	44%	2%	55%	13.1
Thin Topsoil Cover	41%	3%	56%	13.5

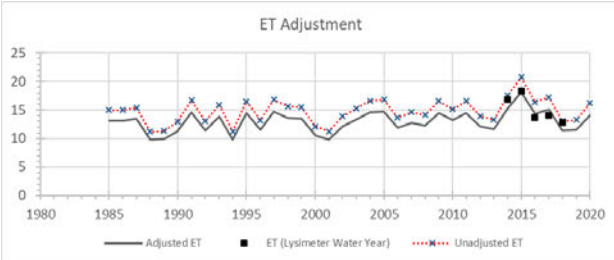
TABLE A-A3. ADJUSTED WATER BALANCE COMPONENTS (1984–2060) FOR UNCOVERED AREAS

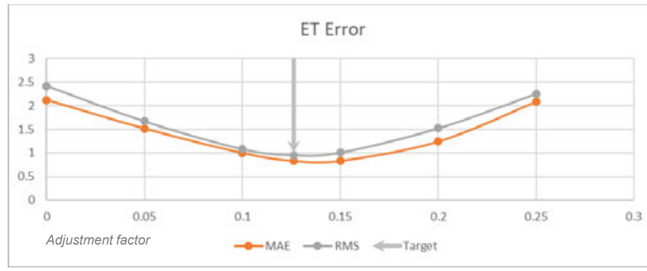
Cover Type	ET	Runoff	Infiltration	Infiltration
	% of precipitation			inches
Exposed Overburden Pile (EOP)	38%	1%	61%	14.6
Open Mine Pit (OMP)	37%	0%	63%	15.2

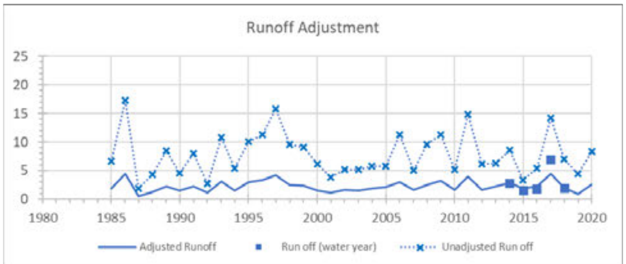
TABLE A-A4. CAPILLARY COVER OPTIMAL BENCH SPACING ALONG 3:1 SLOPE.

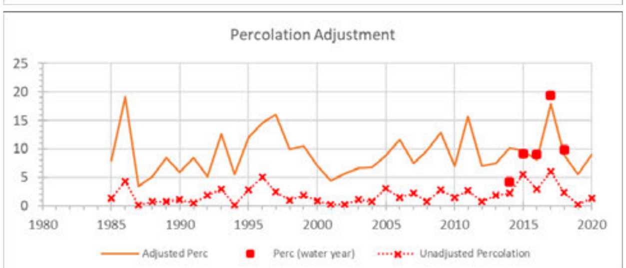
Estimated Long-Term Average Percolation	Estimated Optimal Bench Spacing	Estimated Effective Percolation with Optimal Bench Spacing
Inches per year	feet	Inches per year
5	190	1.7
7.5	135	2.6
10	105	3.4
12	90	3.9

Note: Assumes a constant sloping cover consisting of 2 ft of uncompacted Dinwoody material overlying screened chert.







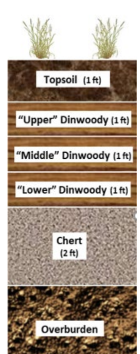


Adjusted Deep Dinwoody Water Balance Components (1984-2060)

in/yr	Runoff	Percolation	ET
Min	0.6	3.5	9.8
Max	4.5	19.0	18.1
Avg	2.3	9.2	12.6

Notes:

Water balance adjustment is based on water years 2015–2018. OKC (2019) indicates the Deep Dinwoody cover evolved due to a drying and wetting processes, resulting in an increase of hydraulic conductivity from 1e-6 to 2e-5 cm/s of the lower Dinwoody layer. As a result, cover performance for water year 2014 is assumed to be non-representative of the *evolved* cover characteristics and is excluded in the adjustment process.



J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

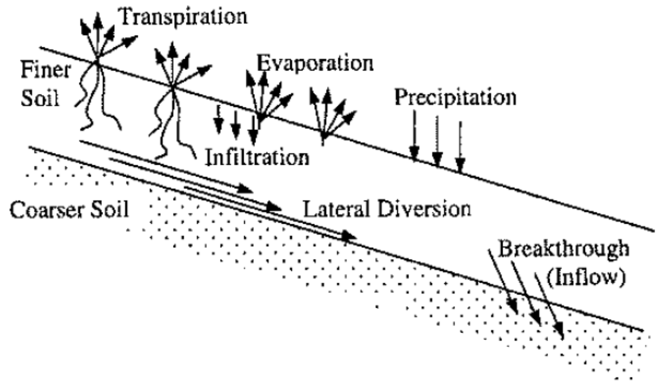
FIGURE A-A1

DEEP DINWOODY COVER WATER BALANCE COMPONENT ADJUSTMENT

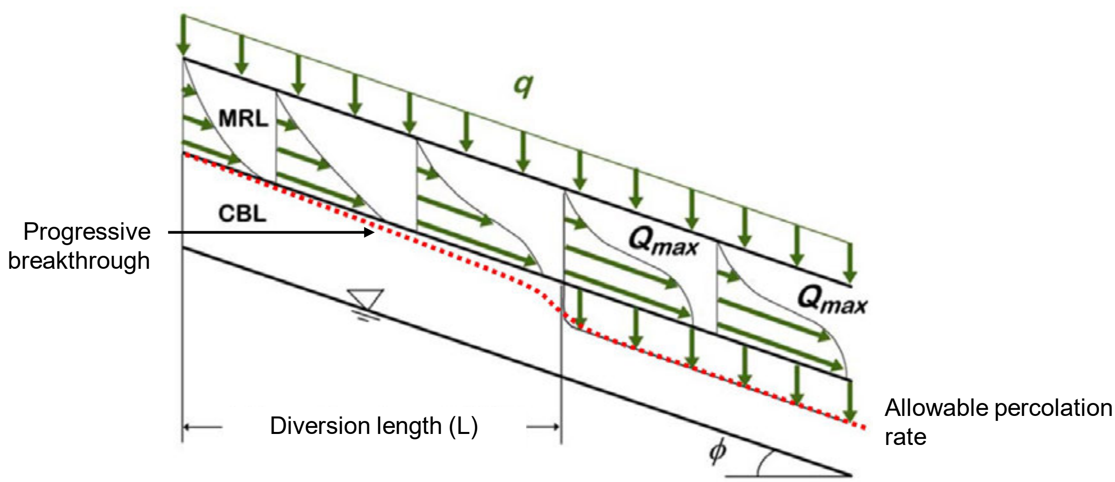
DATE: MARCH 2020		FORMATION ENVIRONMENTAL
BY: PHT	FOR: ACK	

S:\Jobs\Smoky\CERCLA\FS\Model\GW_rev2019\RUN_ADJUST_QA_V14_adjust.xlsx

(a)



(b)



Notes:
(a) Modified from Morris and Stormont (1999)
(b) Modified from Parent and Cabral (2006).

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

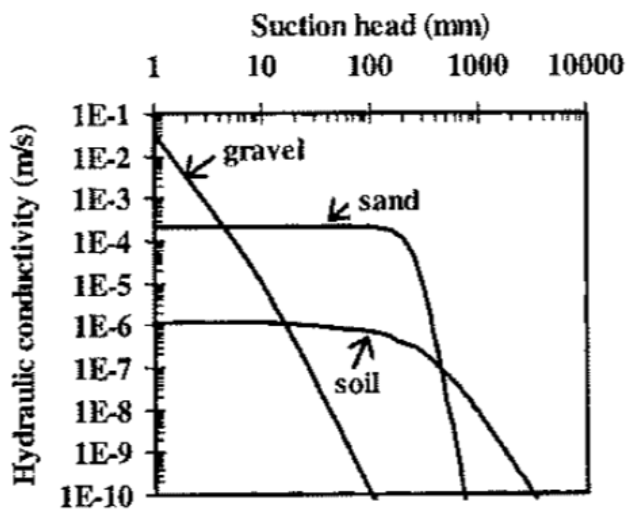
FIGURE A-A2

CAPILLARY COVER SCHEMATIC AND WATER FLOW VECTORS
DRAFT

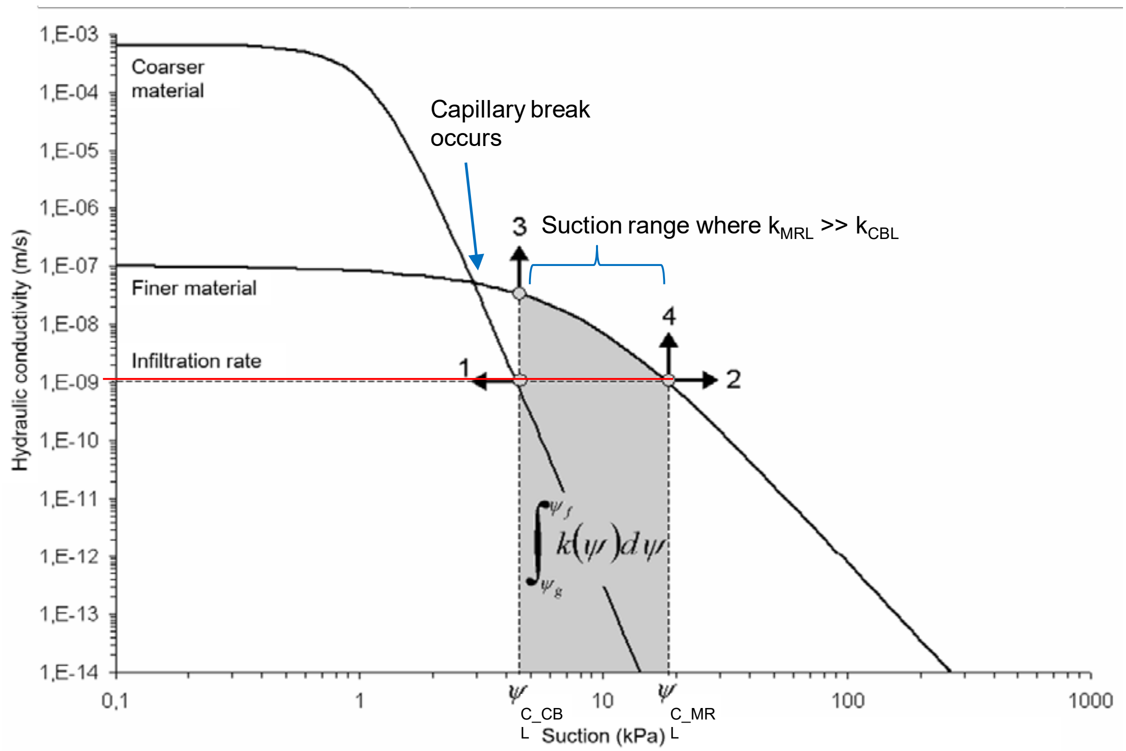
DATE: MARCH 2020
BY: CFJ FOR: PHT

FORMATION ENVIRONMENTAL

(a)



(b)



J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

FIGURE A-A3

HYDRAULIC CONDUCTIVITY FUNCTIONS OF TYPICAL CAPILLARY COVER MATERIALS - DRAFT

DATE: MARCH 2020
BY: CFJ
FOR: PHT

FORMATION ENVIRONMENTAL

Notes:
(a) Morris and Stormont (1999)
(b) Modified from Parent and Cabral (2003).

From OKC (July 9, 2015)

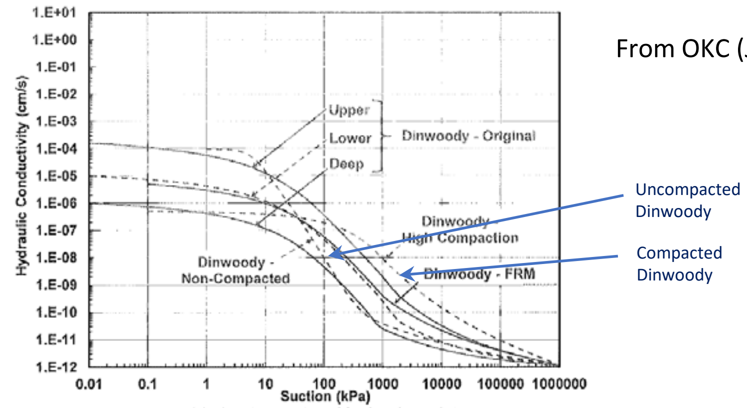
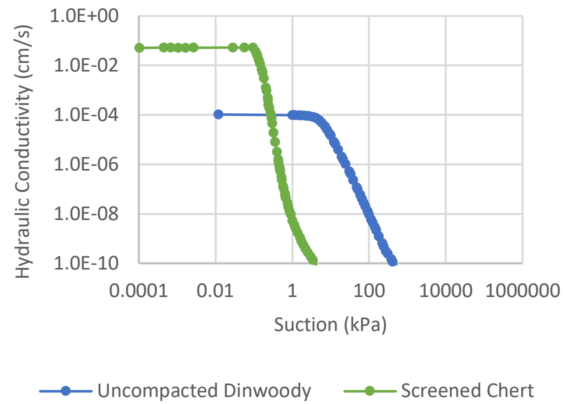


Figure A4 Hydraulic conductivity functions evaluated for the Dinwoody layers.



K-functions for potential capillary cover system materials

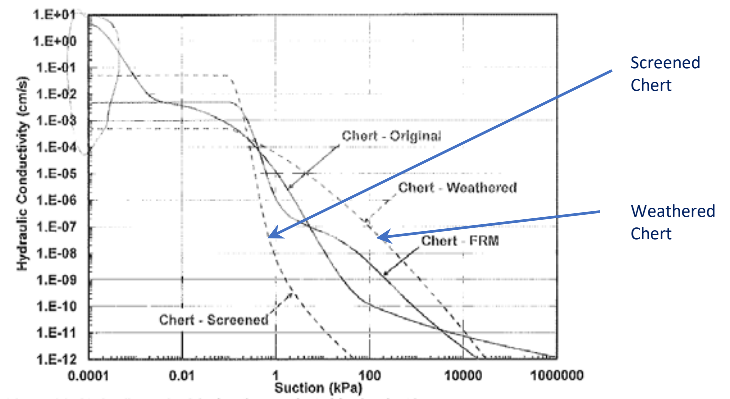
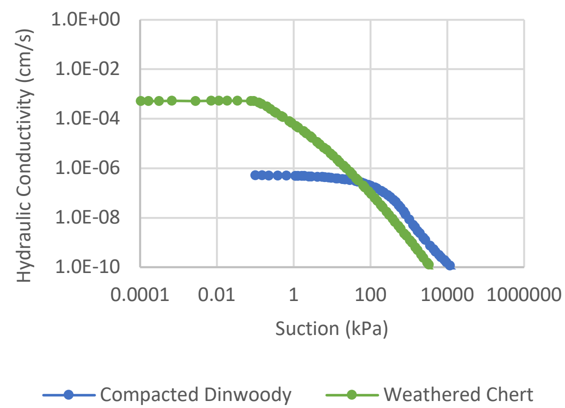
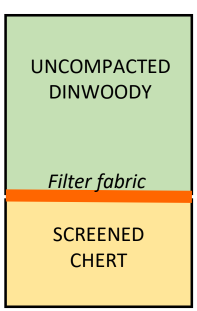


Figure A6 Hydraulic conductivity functions evaluated for the chert layer.

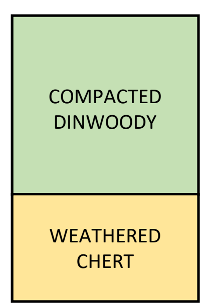


K-functions for materials not suitable for potential capillary cover system

Materials and profile for potential capillary cover system



Materials not suitable for potential capillary cover system



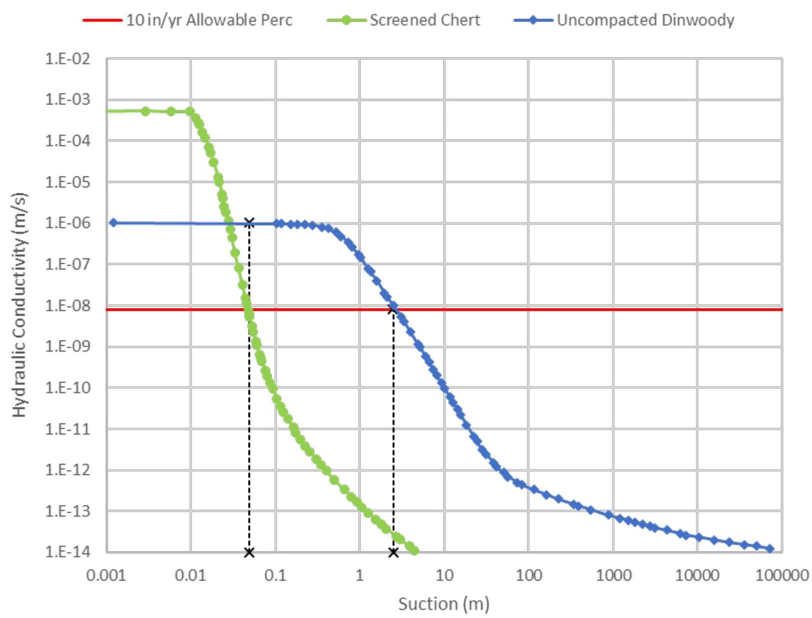
J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

FIGURE A-4
COMPARISON OF MATERIALS FOR CAPILLARY COVER SYSTEM
DRAFT

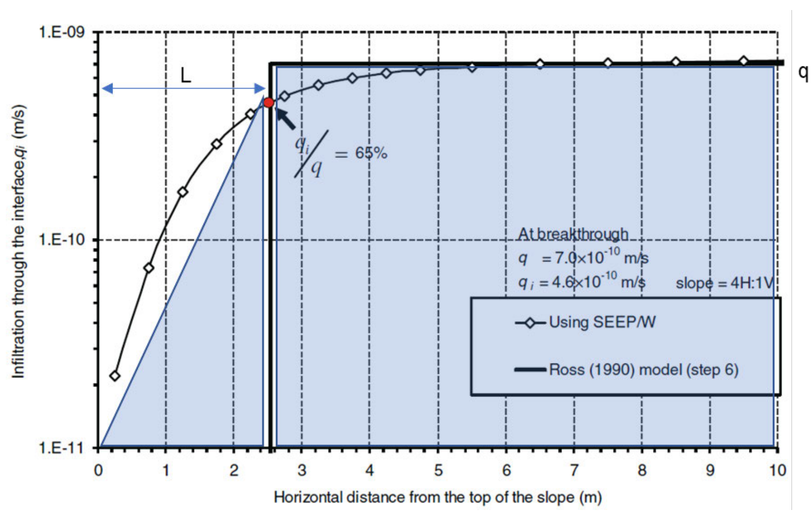
DATE: MARCH 2020
BY: PHT FOR: AKC

FORMATION ENVIRONMENTAL

(a)



(b)



Notes:
(a) k-functions from O'Kane (2015). The diversion capacity is proportional to the area under the blue curve between the dashed lines. The example shown is for an allowable percolation rate of 10 in/yr;
(b) Modified from Parent and Cabral (2006).

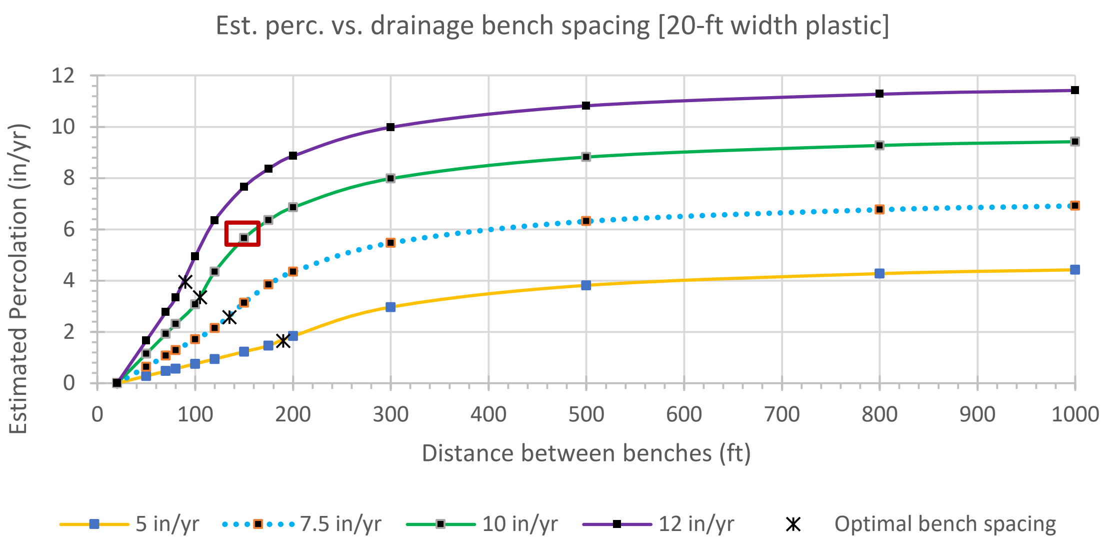
J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

FIGURE A-A5

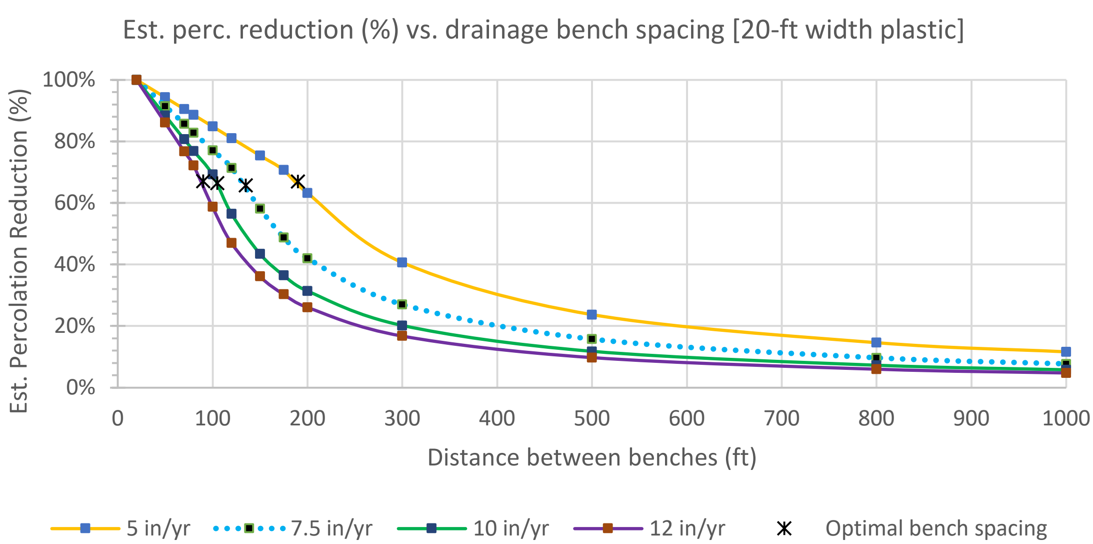
DIVERSION CAPACITY, DIVERSION LENGTH, AND EFFECTIVE PERCOLATION ESTIMATION - DRAFT

DATE: MARCH 2020		FORMATION ENVIRONMENTAL
BY: CFJ	FOR: PHT	

(a)



(b)



Note:
Estimated optimal drainage bench spacing for each allowable percolation rate indicated with an asterisk.

5.7 in/yr effective percolation rate used in modeling analyses (Appendix A), with 150-ft bench spacing.

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

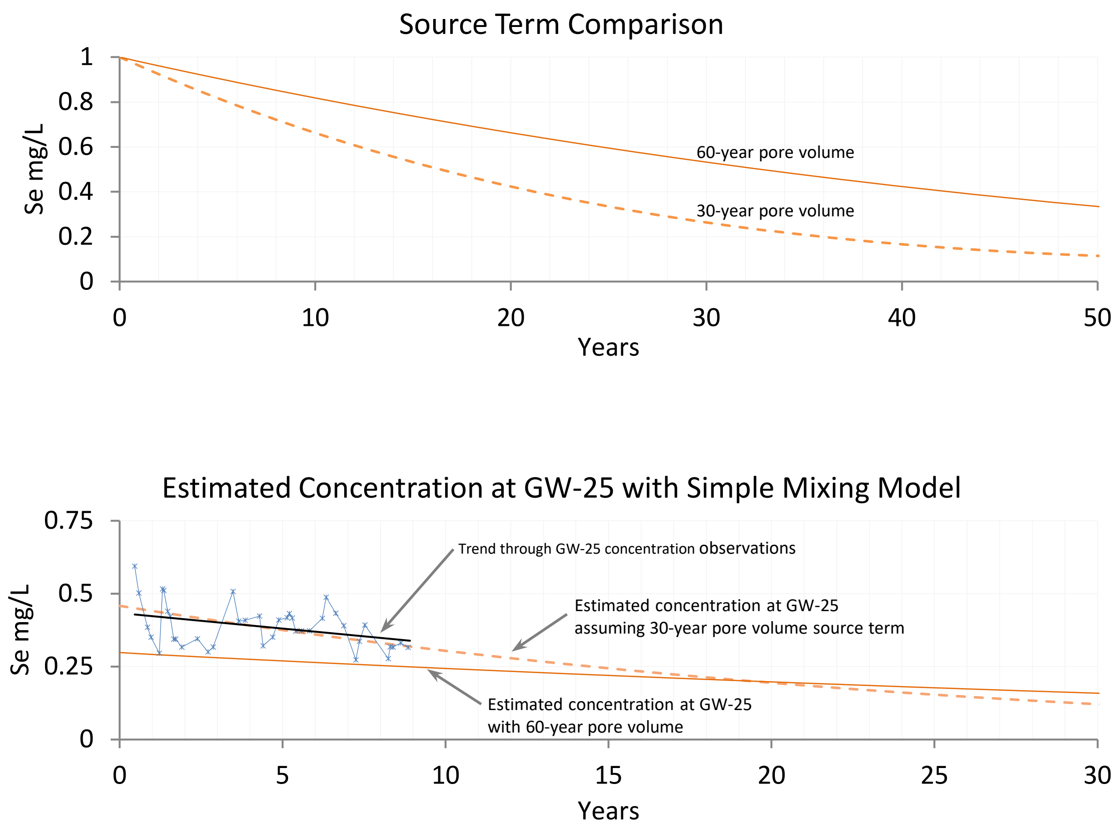
FIGURE A-A6

ESTIMATED PERCOLATION AND PERCENT REDUCTION WITH DRAINAGE BENCH SPACING - DRAFT

DATE: MARCH 2020
BY: CFJ
FOR: PHT

FORMATION ENVIRONMENTAL

S:\Jobs\Smoky\CERCLA\FS\Model\Capillary\Calc\DiversionLength_Smoky_v3.xlsx



Notes:

PV = Pore volume

DRAFT

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

FIGURE A-A7

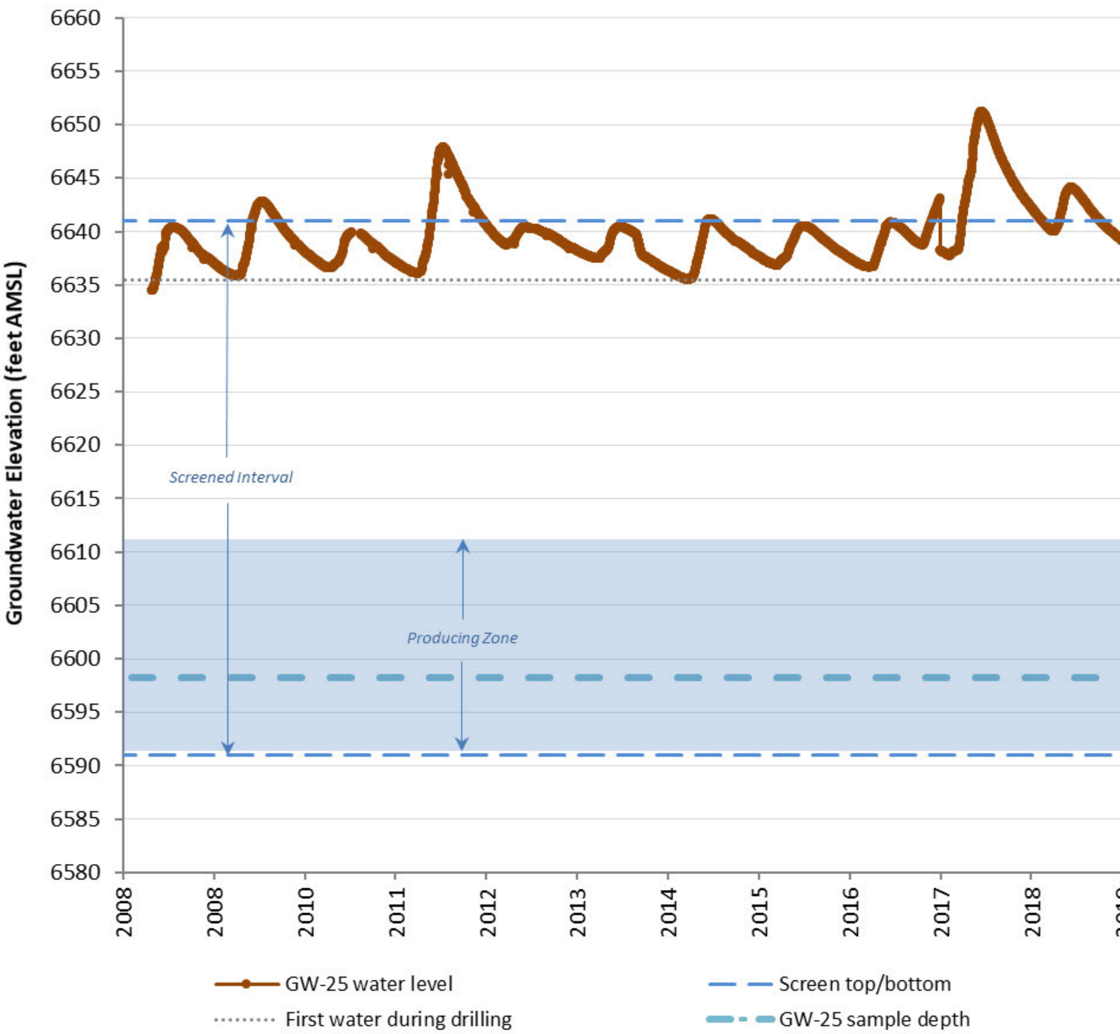
SOURCE TERM ASSUMPTIONS AND ESTIMATED SELENIUM CONCENTRATIONS AT GW-25 WITH MIXING MODEL

DATE: JANUARY 2020
BY: WSB
FOR: ACK

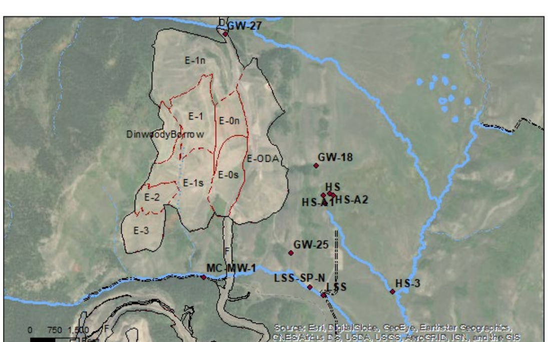
FORMATION ENVIRONMENTAL

S:\Jobs\Smoky\CERCLA\FS\Model\GW_rev2019\SrcTerm_GW25.xlsx

"S:\JOBS\SMOKY\CERCLA\FS\FSTM2\APPX\A-GW\FIGA-A8_GW25_SCREENINTERVAL.PPTX"



DRAFT



J.R. SIMPLOT COMPANY
SMOKY CANYON MINE
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

FIGURE A-A8

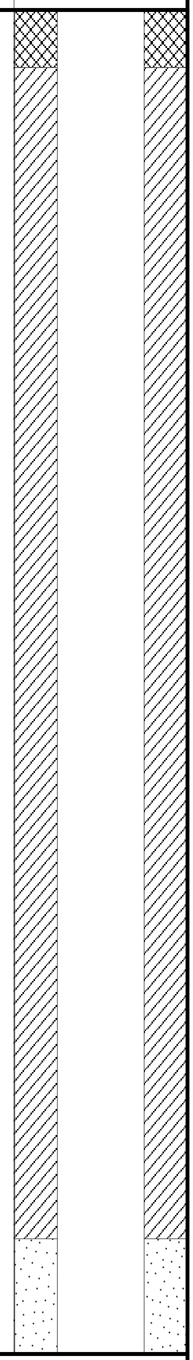
GROUNDWATER ELEVATION AND SCREEN INTERVAL (GW-25)

DATE: JANUARY 2020		FORMATION ENVIRONMENTAL
BY: PHT	FOR: ACK	

"S:\Jobs\Smoky\CERCLA\FS\Model\GW\DAF\gw25\GW25Hydro.xlsx"

J.R. SIMPLOT CO. SMOKY CANYON MINE	Drilling Company: **Thomas Drilling, Tyson Thomas**	Logged By: **B. Cotton**	Northing: **4720974.92**
	Drilling Method: **Downhole Hammer**	Borehole Diameter: **10-inch**	Easting: **490289.99**
	Sampling Method: **Cuttings**	Ground Elevation: **6711.377**	Total Depth (ft bgs): **125**
Project Number: **0442-004-900**	Drilling Fluid: **Air, Water, Foam**	Date Started: **9/21/2007**	Date Completed: **9/21/2007**

Depth (ft)/ Elevation (ft AMSL)	Description	Water Produced	Water Encountered	Well Construction
0 / 6710	Sandy Silt (ML). Dark yellow-brown (10YR 4/4) sandy silt trace gravel. Dry. Drilling action even and smooth.	Dry		
	Sandy Silt with Gravel(ML). Yellow-brown (10YR 5/4) sandy silt (80%); fine gravel (20%). Gravel consists of lit gray very fine-grained sandstone and limestone. Maximum gravel dimension 10 mm. Drilling action even and smooth.			
10 / 6700	Sandstone. Yellow-brown (10YR 5/4), highly friable, non-calcareous, silty very fine-grained sandstone (50%) and light brown-gray (10YR 5/2), non-friable, non-calcareous very fine-grained sandstone (50%). 20 ft – mostly light brown gray very fine-grained sandstone with black speckles, some calcite mineralization on fracture faces; yellow brown silty very fine-grained sandstone is completely pulverized by drill. Drilling action even and smooth.	Injection		
20 / 6690				
	Sandstone. Light gray (10YR 7/1) with black mottling, non-friable, calcareous silty very fine-grained sandstone (50%); brown-yellow (10YR 6/6) with yellow-brown (10YR 5/6) mottling, friable, non-calcareous silty very fine-grained sandstone with calcite veins. Drilling action even and smooth.			
30 / 6680	Claystone and Limestone. Light gray and brown gray (10YR 5/1-6/2), non-friable claystone with calcite in veins and on fracture faces. Dark gray (10YR 4/1) non-friable limestone. Fractured, chips to 40 mm. Drilling action crunchy.			
40 / 6670	Limestone/Calcareous Siltstone. Gray (10YR 6/1) with black mottling, non-friable argillaceous limestone/calcareous siltstone. Trace yellow staining and fragments of limestone-very fine-grained sandstone breccia. Calcite mineralization on some fracture faces. Drilling action crunchy.	Injection		
50 / 6660	Sandstone. Gray (10YR 6/1) calcareous and light yellow-brown (10YR 6/4) non-calcareous very fine-grained sandstone. Variations with depth as follows: 40 ft – yellow-brown sandstone has trace rust-like inclusions. Both gray and yellow-brown sandstone are non-friable, fractured, chips to 40 mm. 44 ft – brown-yellow (10YR 6/6) and light gray (10YR 7/2), calcareous, friable to non-friable. 50 ft – light gray (10YR 7/1), calcareous, non friable, massive, chips < 10 mm. 55 ft – yellow-brown, highly friable, non-calcareous silty very fine-grained sandstone; gray very fine-grained sandstone, friable to non-fraible, with calcite veins. 60 ft – same as above, contains some brown (7.5YR 5/4) clay. 64 ft – gray with black speckles, calcareous very fine-grained sandstone; yellow-brown highly friable silty very fine-grained sandstone with rust-like inclusions to 1 mm. Some chips with combination of both types. 70 ft – brown-yellow			
60 / 6650				
70				



Well Casing:	**Monoflex Sch-80 PVC, 4-in. dia.**	Filter Pack:	**Colorado silica 20-40 (64-65 ft)** **Colorado silica 10-20 (65-123 ft)**
Well Screen:	**Boart Longyear Sch-80 PVC, 4-in. dia., 0.020" slot**	Seal:	**Portalnd Type I-II Cemennt (0-3ft)** **CETCP Volclay Coarse Chips (3-64)'**

Boring Log and Well Completion: GW-25

FIGURE A-A9

J.R. SIMPLOT CO. SMOKY CANYON MINE	Drilling Company: **Thomas Drilling, Tyson Thomas**	Logged By: **B. Cotton**	Northing: **4720974.92**
	Drilling Method: **Downhole Hammer**	Borehole Diameter: **10-inch**	Easting: **490289.99**
	Sampling Method: **Cuttings**	Ground Elevation: **6711.377**	Total Depth (ft bgs): **125**
Project Number: **0442-004-900**	Drilling Fluid: **Air, Water, Foam**	Date Started: **9/21/2007**	Date Completed: **9/21/2007**

Depth (ft)/ Elevation (ft AMSL)	Description	Water Produced	Water Encountered	Well Construction
70 / 6640, 80 / 6630	highly friable silty very fine-grained sandstone, slightly calcareous; gray to light yellow-brown (10YR 6/6) calcareous, very fine-grained sandstone, some chips with sparry calcite. 75 ft – gray to light yellow-brown (2.5Y 6/3) very fine to medium-grained non-calcareous sandstone, some chips gray and yellow-brown mottled. 80 ft – brown-yellow with black speckles, friable to highly friable, very fine-grained calcareous sandstone; gray non-friable very fine-grained calcareous sandstone. Drilling action intermittently rough.		DTW = 75.8 on 9/21/2007; First water	
	Claystone. Gray-brown, slightly calcareous, non friable, trace of friable to highly friable yellow-red mottled (5YR 5/8-4/6) concretions. Drilling action intermittently rough.			
90 / 6620	Sandstone. Gray to yellow-brown (10YR 7/2 to 6/4) very fine-grained sandstone, slightly calcareous. 95 ft – mostly yellow-brown, friable to highly friable, non-calcareous; some gray, slightly calcareous, non-friable. Drilling action intermittently rough.	3 to 5 gallons per minute		
100 / 6610, 110 / 6600	Sandstone and Siltstone. Pale brown (10YR 7/4) with black specks, friable, non-calcareous very fine grained sandstone. Yellow-brown (10YR 5/4) calcareous siltstone with calcite mineralization of irregular faces. 104 ft – siltstone is light yellow-brown and dark yellow-brown mottled (10YR 6/4-4/6) slightly calcareous (30%); light yellow-brown very fine-grained non friable calcareous sandstone; gray (10YR 6/1) very fine non-calcareous sandstone with calcite veins. Chips to 40 mm, fractured. Drilling action intermittently rough.	20 gallons per minute; 20 gallons per minute		
120 / 6590	Sandstone. Brown-gray (10YR 6/2) non-friable, very fine-grained calcareous sandstone with trace orange staining on irregular faces. 114-120 ft – some vuggy chips with calcite mineralization. Uniform chip size 10 to 20 mm, massive. Producing up to 20 gpm of groundwater during drilling from 109 to 118 ft, no groundwater produced during drilling from 119 to 124 ft. Drilling action intermittently rough.	0 gallons per minute; Injection	Pump Intake Depth	
	Sandstone with Chert. Brown-gray (10YR 6/2) non-friable, very fine-grained calcareous sandstone with brown oxide coating (80%); black cherty very fine-grained sandstone (20%). Drilling action intermittently rough.			

Well Casing: **Monoflex Sch-80 PVC, 4-in. dia.**

Well Screen: **Boart Longyear Sch-80 PVC, 4-in. dia., 0.020" slot**

Filter Pack: **Colorado silica 20-40 (64-65 ft)**
Colorado silica 10-20 (65-123 ft)

Seal: **Portalnd Type I-II Cemennt (0-3ft)**
CETCP Volclay Coarse Chips (3-64)'

APPENDIX B

COST ESTIMATE FOR REMEDIAL ALTERNATIVES

DRAFT

APPENDIX B
Cost Estimate for Remedial Alternatives

Prepared for:

J.R. Simplot Company
Smoky Canyon Mine
1890 Smoky Canyon Road
Afton, Wyoming 83110

TABLE OF CONTENTS

Tables

LIST OF ABBREVIATIONS

BCY	Bulk Cubic Yard
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CY	Cubic Yard
F	Future Worth
FBR	Fluidized Bed Bioreactor
FS	Feasibility Study
FSTM#2	Feasibility Study Technical Memorandum #2
gpm	Gallons Per Minute
i	Discount Rate
ICIAP	Institutional Control Implementation and Assurance Plan
ICs	Institutional Controls
KWh	Kilowatt Hours
LCY	Loose Cubic Yard
LF	Linear Foot
LS	Lump Sum
MCL	Maximum Contaminant Level
MNA	Monitored Natural Attenuation
MSF	Thousand Square Feet
n	Time Period (years)
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ODA	Overburden Deposit Area
O&M	Operations & Maintenance
PRB	Permeable Reactive Barrier
PV	Present Value
QA/QC	Quality Assurance/Quality Control
RO	Reverse Osmosis
SF	Square Feet

SLF	Salt Lake Formation
SY	Square Yard
UF	Ultrafiltration
USEPA	United States Environmental Protection Agency
WTP	Water Treatment Plant

1 INTRODUCTION

This appendix provides a brief description of costs and supporting detailed cost estimate tables for the media-specific remedial alternatives developed as part of the Feasibility Study (FS) for the J.R. Simplot Company (Simplot) Smoky Canyon Mine. As outlined in the United States Environmental Protection Agency (USEPA) fact sheet *The Role of Cost in the Superfund Remedy Selection Process* (USEPA 1996), cost is a critical factor in the process of identifying a preferred remedy under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as established under the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). In fact, CERCLA and the NCP "require that every remedy selected must be cost-effective."

2 COST ESTIMATION APPROACH

Cost estimates were developed for the Smoky Canyon Mine FS in accordance with procedures in the USEPA *Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (USEPA 2000) for the purpose of comparing remedial alternatives during the remedy selection process. Remedial action alternative cost estimates for the detailed analysis are intended to provide a measure of total resource costs over time (i.e., "life cycle costs") associated with any given alternative. The level of accuracy for detailed analysis cost estimates is expected to be within a range of -30 percent to +50 percent of actual costs.

Cost estimates include capital costs, operations and maintenance (O&M) costs, and periodic costs. For remedial alternative cost estimates developed during the FS, the conventional distinctions between capital and O&M costs were used. Capital costs considered during the FS include design and construction while O&M costs include both short-term and long-term O&M. Periodic costs (e.g., replacement or repair costs, and 5-year review costs) can occur at any time during the O&M period (both short-term and long-term). The cost estimates also include contingencies, costs for professional and technical services (e.g., construction management), and mobilization/demobilization costs. These cost categories are described below.

2.1 CAPITAL COSTS

As defined in USEPA guidance (USEPA 2000), capital costs are those expenditures that are required to construct a remedial action. They are exclusive of costs required to operate or maintain the action throughout its lifetime. Capital costs consist primarily of expenditures initially incurred to build or install the remedial action (e.g., construction of a groundwater treatment system and related site work). Capital costs include all labor, equipment, and material costs, including contractor markups such as overhead and profit, associated with activities such as mobilization/demobilization; monitoring; site work; installation of extraction, containment, or treatment systems; and disposal. Capital costs also include expenditures for professional/technical services that are necessary to support construction of the remedial action.

2.2 Annual O&M Costs

O&M costs are those post-construction costs necessary to ensure or verify the continued effectiveness of a remedial action (USEPA 2000). These costs are estimated mostly on an annual basis. Annual O&M costs include all labor, equipment, and material costs, including contractor markups such as overhead and profit, associated with activities such as monitoring; operating and maintaining extraction, containment, or treatment systems; and disposal. Annual O&M costs also include expenditures for professional/technical services necessary to support O&M activities.

2.3 Periodic Costs

As defined in USEPA guidance (USEPA 2000), periodic costs are those costs that occur only once every few years (e.g., equipment replacement and 5-year reviews) or expenditures that occur only once during the entire O&M period or remedial timeframe (e.g., site closeout and/or remedy failure/replacement). These costs may be either capital or O&M costs, but because of their periodic nature, it is more practical to consider them separately from other capital or O&M costs in the estimating process.

2.4 Contingencies

Contingencies are factored into the cost estimate for each remedial alternative component to cover unknowns, unforeseen circumstances, or unanticipated conditions. The two main types of contingency are scope and bid. Scope contingency covers unknown costs due to scope changes that may occur during design. Bid contingency covers unknown costs associated with constructing or implementing a given project scope. USEPA guidance estimates that scope contingencies typically range from 10 to 25 percent and that bid contingencies typically range from 10 to 20 percent (USEPA 2000).

2.5 Professional/Technical Services Costs

Costs associated with remedial design, construction management and technical support are estimated by applying percentages to total construction and O&M costs plus contingency. USEPA guidance (USEPA 2000) provides rule-of-thumb percentages for ranges of total costs and these are considered in the FS alternative costs. However, as discussed above, estimated costs for these components may be lower than USEPA guidance, because similar work has been performed at Smoky Canyon Mine.

2.6 Mobilization/Demobilization Costs

Consistent with USEPA guidance, mobilization/demobilization costs include: mobilization and demobilization of construction equipment and facilities; submittals/implementation plans (such as construction quality control plans, construction schedules, environmental protection plans, training and medical certifications, materials handling/transportation and disposal plans, permits, site safety and health plans, sampling and analysis plans, site security plans, site work plans, storm water pollution prevention plans); temporary facilities (such as office trailers, decontamination facilities, storage facilities, security fencing, signs, roads and parking); temporary utilities; temporary relocation of roads/structures/utilities; and post construction submittals (such as O&M manuals, as-built drawings, quality assurance/quality control [QA/QC] documentation) (USEPA 2000). Consistent with previous discussions, costs estimated for the FS take into account the fact that considerable remediation work has been completed and is ongoing at Smoky Canyon Mine and that much of the required equipment and personnel are local and that many of the required plans are already in existence.

2.7 Present Value Analysis

For each alternative, a -30 to +50 percent cost estimate is developed in accordance with procedures in USEPA's *Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (USEPA 2000). Cost estimates are based on conceptual engineering and design and are expressed in terms of 2020 dollars. This analysis is used to evaluate the capital, O&M, and periodic costs of a remedial alternative based on its present value. A present value analysis compares expenditures for various alternatives where those expenditures occur over different time periods. By discounting all costs to a common base year, the costs for different remedial action alternatives can be compared based on a single cost figure for each alternative.

The total present value for a single alternative is equal to the full amount of all costs incurred through the end of the first year of operation, plus the series of expenditures in following years reduced by the appropriate future value/present value discount factor. This analysis allows the comparison of remedial alternatives on the basis of a single cost representing an amount that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the remedial action over its planned life. The present value calculations are based on the following fundamental equation:

$$PV = (1 / (1+i)^t)(x_t)$$

Where: PV = present value ($)
x = Payment ($)
i = discount rate (%)
t = time (year)

A discount rate of 7 percent was used for the present value calculations, consistent with USEPA guidance and directives (USEPA 1988 and 2000). The discount rate represents the anticipated difference between the rate of inflation and investment return. The time period selected for long-term O&M and monitoring was 30 years (USEPA 1988).

3 Cost Estimates for Media-Specific Remedial Alternatives

Detailed cost estimates were developed for remedial alternatives for Wells Formation groundwater, surface water, alluvial groundwater, and solids and soils. All costs were obtained from *RS Means 2018 Heavy Construction Costs 32nd Annual Edition* or from Simplot based on actual construction costs. Cost estimates are within a range of -30 percent to +50 percent of actual costs, as recommended in USEPA guidance (USEPA 2000).

3.1 Wells Formation Groundwater

As detailed in Feasibility Study Technical Memorandum #2 (FSTM#2), the remedial alternatives for Wells Formation groundwater are:

- Alternative WG-1 – No Further Action
- Alternative WG-2 – Monitored Natural Attenuation (MNA)
- Alternative WG-3 – Institutional Controls (ICs)
- Alternative WG-4 – 5-Foot Dinwoody or Salt Lake Formation (SLF)/Chert Covers, ICs and MNA
- Alternative WG-5 – Capillary Covers, ICs and MNA
- Alternative WG-6 – Enhanced Dinwoody Covers, ICs and MNA
- Alternative WG-7 – Geomembrane Covers, ICs and MNA

A summary of the present value estimates for these alternatives is presented in Table B-1. Detailed present value cost estimate information for these Alternatives are presented in Tables B-1a through B-1g, respectively. The itemized cost breakdown of these Alternatives is in Tables B-1h through B-1k. The remedial alternatives are briefly described, and key assumptions used in developing the cost estimate for each are summarized below.

3.1.1 Alternative WG-1 – No Further Action

No additional actions would be taken under Alternative WG-1. The cost estimate for Alternative WG-1 does not include any capital, O&M costs or periodic costs.

3.1.2 Alternative WG-2 – Monitored Natural Attenuation (MNA)

Alternative WG-2 consists of Monitored Natural Attenuation (MNA) to reduce contamination in Wells Formation groundwater. Long-term groundwater monitoring would be required to track MNA progress over time.

There would not be capital costs associated with this alternative. O&M costs would be associated with the implementation of groundwater monitoring and analysis. Annual O&M costs occur in Year 0 through 30. Periodic costs for the CERCLA 5-year review occur in Year 5, 10, 15, 20, 25 and 30.

3.1.3 Alternative WG-3 – Institutional Controls (ICs)

Alternative WG-3 consists of ICs (deed restrictions) to prevent the use of Wells Formation groundwater with selenium concentrations above the maximum contaminant level (MCL) as a source of drinking water on Simplot-owned land in Sage Valley, development of an Institutional Control Implementation and Assurance Plan (ICIAP), implementation of deed restrictions, and CERCLA 5-year reviews.

Capital costs occur in Year 0. O&M costs include the same groundwater monitoring as described in Alternative WG-2. Periodic costs occur in Years 5, 10, 15, 20, 25, and 30.

3.1.4 Alternative WG-4 – 5-Foot Dinwoody or Salt Lake Formation (SLF)/Chert Covers, ICs and MNA

Alternative WG-4 would include construction of 5-Foot Dinwoody or SLF/chert covers on the 194-acre target cover areas, ICs and MNA. The cover would consist of a 2-foot layer of chert or limestone overlain by an approximately 3-foot layer of Dinwoody or Salt Lake Formation material. ICs under Alternative WG-4 would be the same as Alternative WG-3. Monitoring and O&M would be performed on the covers to verify their integrity. Long-term groundwater monitoring would be required to evaluate the effectiveness of the covers, and the progress of MNA.

Capital costs for Alternative WG-4 include direct construction costs for the cover, stormwater controls and ICs (deed restrictions), and indirect construction costs for mobilization and demobilization and erosion control. Capital costs occur in Years 0 through 1. The cost estimate includes annual O&M costs to maintain the effectiveness and performance of the covers and for long-term groundwater monitoring. Annual O&M costs begin in Year 2, after the completion of cover construction, and continue through Year 30. O&M costs are assumed to be higher for the first five years. Periodic costs for the CERCLA 5-year review occur in Years 5, 10, 15, 20, 25 and 30.

3.1.5 Alternative WG-5 – Capillary Covers, ICs and MNA

Alternative WG-5 would include construction of capillary covers on the target cover areas, ICs and MNA. The cover would consist of (from bottom to top) a 6-inch layer of screened Dinwoody or Salt Lake Formation material, a 1-foot screened chert/limestone layer, filter fabric and 2 feet of uncompacted Dinwoody or Salt Lake Formation material. ICs under Alternative WG-5 would be the same as Alternative WG-3. Monitoring and O&M would be performed on the covers to verify their integrity. Long-term groundwater monitoring would be required to evaluate the effectiveness of the covers, and the progress of MNA.

Capital costs for Alternative WG-5 include direct construction costs for the cover, stormwater controls and ICs (deed restrictions), and indirect construction costs for mobilization and demobilization and erosion control. Capital costs occur in Years 0 through 1. The cost estimate includes annual O&M costs to maintain the effectiveness and performance of the covers and for long-term groundwater monitoring. Annual O&M costs begin in Year 2, after the completion of cover construction, and continue through Year 30. As for Alternative WG-4, O&M costs are assumed to be higher for the first five years. Periodic costs for the CERCLA 5-year review occur in Years 5, 10, 15, 20, 25 and 30.

3.1.6 Alternative WG-6 – Enhanced Dinwoody Covers, ICs and MNA

Alternative WG-6 would include construction of Enhanced Dinwoody covers on the target cover areas, ICs and MNA. The cover would consist of (from bottom to top) 6 inches of screened Dinwoody or Salt Lake Formation material, 6 inches of Enhanced Dinwoody (screened Dinwoody with 5% bentonite), a 12-inch drainage layer (chert/limestone), filter fabric, 2 feet of loose Dinwoody or Salt Lake Formation material, overlain by 1 foot of topsoil. ICs under Alternative WG-6 would be the same as Alternative WG-3. Monitoring and O&M would be performed on the covers to verify their integrity. Long-term groundwater monitoring would be required to evaluate the effectiveness of the covers, and the progress of MNA.

Capital costs for Alternative WG-6 include direct construction costs for the cover, stormwater controls and ICs (deed restrictions), and indirect construction costs for mobilization and demobilization and erosion control. Because of the number of layers (e.g., the 100% compact screened Dinwoody and bentonite amended layers), it is assumed that only 30 to 35 acres will be constructed each year with the limited construction season. This will lead to several years of construction to complete the 194 acres. Capital costs occur in Years 0 through 5. The cost estimate includes annual O&M costs to maintain the effectiveness and performance of the covers and for long-term groundwater monitoring. Annual O&M costs begin in Year 6, after the completion of cover construction, and continue through Year 30 and are higher for the first five years. Periodic costs for the CERCLA 5-year review occur in Years 5, 10, 15, 20, 25 and 30.

3.1.7 Alternative WG-7 – Geomembrane Covers, ICs and MNA

Alternative WG-7 would include construction of geomembrane covers on the target cover areas, ICs and MNA. The covers would conceptually consist of multiple layers to reduce infiltration into the overburden material, including a geomembrane. For cost purposes, the cover would include a 1-foot-thick protective subgrade, a geomembrane layer and 3 feet of Dinwoody/topsoil on top of the hydraulic barrier layer. ICs under Alternative WG-7 would be the same as Alternative WG-3. Monitoring and O&M would be performed on the covers to verify their integrity. Long-term groundwater monitoring would be required to evaluate the effectiveness of the covers, and the progress of MNA.

Capital costs for Alternative WG-7 include direct construction costs for the cover, stormwater controls and ICs (deed restrictions), and indirect construction costs for mobilization and demobilization and erosion control. Capital costs occur in Years 0 through 1. The cost estimate includes annual O&M costs to maintain the effectiveness and performance of the covers and for long-term groundwater monitoring. Annual O&M costs begin in Year 2, after the completion of cover construction, and continue through Year 30. O&M costs are higher for the first five years after construction. Periodic costs for the CERCLA 5-year review occur in Years 5, 10, 15, 20, 25 and 30.

3.2 Surface Water

As detailed in FSTM#2, the remedial alternatives for surface water are:

- Alternative SW-1 – No Further Action
- Alternative SW-2 – 5-Foot Dinwoody or SLF/Chert Covers
- Alternative SW-3 – Capillary Covers
- Alternative SW-4 – Enhanced Dinwoody Covers
- Alternative SW-5 – Geomembrane Covers
- Alternative SW-6a – Treatment of Water Discharging at Hoopes Spring (2,000 gpm)
- Alternative SW-6b – Treatment of Water Discharging at Hoopes Spring (3,000 gpm)

A summary of the present value estimates for these alternatives is presented in Table B-2. Detailed present value cost estimate information for Alternatives SW-1, SW-2, SW-3, SW-4, SW-5, SW-6a andSW-6 b are presented in Tables B-2a through B-2g, respectively. The itemized cost breakdown of these Alternatives is in Tables B-2h through B-2n. The remedial alternatives are briefly described, and key assumptions used in developing the cost estimate for each are summarized below.

3.2.1 Alternative SW-1 – No Further Action

No additional actions would be taken under Alternative SW-1. The cost estimate for Alternative SW-1 does not include any capital, O&M, or periodic costs.

3.2.2 Alternative SW-2 – 5-Foot Dinwoody or SLF/Chert Covers

Alternative SW-2 would include construction of 5-Foot Dinwoody or SLF/chert covers on the 194-acre target cover areas to reduce the infiltration of precipitation and consequent release of selenium to Wells Formation groundwater and transport to surface water. In addition, rock covers would be placed as a physical barrier layer on seeps (DS-7 and LP-1) and detention ponds (DP-7 and EP-2) to prevent direct contact with surface water with arsenic concentrations greater than the MCL. Fences and signs to notify people that drinking the water is potentially unsafe may be installed in the interim to prevent contact. Monitoring and O&M would be performed on the covers to verify their integrity. Long-term surface water monitoring would be required to evaluate the effectiveness of the covers.

Capital costs for Alternative SW-2 include direct construction costs for the 5-Foot Dinwoody or SLF/chert covers, stormwater controls, placement of rock covers and fences/signs, and indirect construction costs for mobilization and demobilization and water and erosion control. Capital costs occur in Years 0 through 1. The cost estimate includes annual O&M costs to maintain the effectiveness and permanence of the covers and components of the stormwater controls and for long-term monitoring. Annual O&M costs begin in Year 2, after the completion of cover construction, and continue through Year 30. Costs for O&M of the cover are higher the first five years. Periodic costs for the CERCLA 5-year review occur in Years 5, 10, 15, 20, 25, and 30.

3.2.3 Alternative SW-3 – Capillary Covers

Alternative SW-3 would include construction of capillary covers on the target areas to reduce the infiltration of precipitation and consequent release of selenium to Wells Formation groundwater and transport to surface water. In addition, rock covers would be placed as a physical barrier layer on seeps (DS-7 and LP-1) and detention ponds (DP-7 and EP-2) to prevent direct contact with surface water with arsenic concentrations greater than the MCL. Fences and signs to notify people that the water should not be consumed may be installed in the interim to prevent contact. Monitoring and O&M would be performed on the covers to verify their integrity. Long-term surface water monitoring would be required to evaluate the effectiveness of the covers.

Capital costs for Alternative SW-3 include direct construction costs for the capillary cover, stormwater controls, placement of rock covers and fences and signs, and indirect construction costs for mobilization and demobilization and erosion control. Capital costs occur in Years 0 through 1. The cost estimate includes annual O&M costs to maintain the effectiveness and permanence of the covers and components of the stormwater controls and for long-term monitoring. Annual O&M costs begin in Year 2, after the completion of cover construction, and continue through Year 30. O&M costs are higher for the first five years after construction. Periodic costs for the CERCLA 5-year review occur in Years 5, 10, 15, 20, 25, and 30.

3.2.4 Alternative SW-4 – Enhanced Dinwoody Covers

Alternative SW-4 would include construction of Enhanced Dinwoody covers on the target cover areas to reduce the infiltration of precipitation and consequent release of selenium to Wells Formation groundwater and transport to surface water. In addition, rock covers would be placed as a physical barrier layer on seeps (DS-7 and LP-1) and detention ponds (DP-7 and EP-2) to prevent direct contact with surface water with arsenic concentrations greater than the MCL. Fences and signs to notify people that the water should not be consumed may be installed in the interim to prevent contact. Monitoring and O&M would be performed on the covers to verify their integrity. Long-term surface water monitoring would be required to evaluate the effectiveness of the covers.

Capital costs for Alternative SW-4 include direct construction costs for the Enhanced Dinwoody cover, stormwater controls, placement of rock covers and fences/signs, and indirect construction costs for mobilization and demobilization and erosion control. Because of the number of layers (e.g., the 100% compact screened Dinwoody and bentonite amended layers), it is assumed that only 30 to 35 acres will be constructed each year with the limited construction season. This will lead to several years of construction to complete the 194 acres. Capital costs occur in Years 0 through 5. The cost estimate includes annual O&M costs to maintain the effectiveness and permanence of the covers and components of the stormwater controls and for long-term monitoring. Annual O&M costs begin in Year 6, after the completion of cover construction, and continue through Year 30. O&M costs are higher for the first five years after construction. Periodic costs for the CERCLA 5-year review occur in Years 5, 10, 15, 20, 25, and 30.

3.2.5 Alternative SW-5 – Geomembrane Covers

Alternative SW-5 would include construction of geomembrane covers on the target cover areas to reduce the infiltration of precipitation and consequent release of selenium to Wells Formation groundwater and transport to surface water. In addition, rock covers would be placed as a physical barrier layer on seeps (DS-7 and LP-1) and detention ponds (DP-7 and EP-2) to prevent direct contact with surface water with arsenic concentrations greater than the MCL. Fences and signs to notify people that the water should not be consumed may be installed in the interim to prevent contact. Monitoring and O&M would be performed on the covers to verify their integrity. Long-term surface water monitoring would be required to evaluate the effectiveness of the covers.

Capital costs for Alternative SW-5 include direct construction costs for the geosynthetic cover, stormwater controls, placement of rock covers and fences/signs, and indirect construction costs for mobilization and demobilization and erosion control. Capital costs occur in Years 0 through 1. The cost estimate includes annual O&M costs to maintain the effectiveness and permanence of the covers and components of the stormwater controls and for long-term monitoring. Annual O&M costs begin in Year 2, after the completion of cover construction, and continue through Year 30. O&M costs are higher for the first five years after construction. Periodic costs for the CERCLA 5-year review occur in Years 5, 10, 15, 20, 25, and 30.

3.2.6 Alternative SW-6a – Treatment of Water Discharging at Hoopes Spring (2,000 gpm)

Alternative SW-6a would include continued operation of the existing Hoopes WTP at a rate of 2,000 gpm. Rock covers would be installed as a physical barrier layer on seeps (DS-7 and LP-1) and detention basins (DP-7 and EP-2). Alternative SW-6a would require O&M of the ultrafiltration/reverse osmosis (UF/RO) fluidized bed bioreactor (FBR) treatment system and long-term performance monitoring.

Capital costs for Alternative SW-6a include direct construction costs for rock covers, fences, and signs. Capital costs occur in Year 0. The cost estimate includes annual O&M and monitoring costs for the treatment system and surface water downstream. Annual O&M costs occur in Years 1 through 30. Periodic costs for the CERCLA 5-year reviews occur in Years 5, 10, 15, 20, 25, and 30.

3.2.7 Alternative SW-6b – Treatment of Water Discharging at Hoopes Spring (3,000 gpm)

Alternative SW-6b would include construction of a third parallel treatment train at the existing Hoopes WTP to treat an additional 1,000 gpm for a total of 3,000 gpm. Rock covers would be installed as a physical barrier layer on seeps (DS-7 and LP-1) and detention basins (DP-7 and EP-2). Alternative SW-6b would require O&M of the UF/RO FBR treatment system and long-term performance monitoring.

Capital costs for Alternative SW-6b include direct construction costs for expansion of the treatment system, rock covers, fences, and signs. Capital costs occur in Year 0. The cost estimate includes annual

O&M and monitoring costs for the treatment system and surface water downstream. Annual O&M costs occur in Years 1 through 30. Periodic costs for the CERCLA 5-year reviews occur in Years 5, 10, 15, 20, 25, and 30.

3.3 ALLUVIAL GROUNDWATER

As detailed in FSTM#2, the remedial alternatives for alluvial groundwater are:

- Alternative AG-1 – No Further Action
- Alternative AG-2 – Monitored Natural Attenuation (MNA)
- Alternative AG-3 – Institutional Controls (ICs) and MNA
- Alternative AG-4 – Permeable Reactive Barrier, ICs and MNA

A summary of the present value estimates for these alternatives is presented in Table B-3. Detailed present value cost estimate information for Alternatives AG-1, AG-2, AG-3, and AG-4 are presented in Tables B-3a through B-3d, respectively. The itemized cost breakdown of these Alternatives is in Table B-3e. The remedial alternatives are briefly described, and key assumptions used in developing the cost estimate for each are summarized below.

3.3.1 ALTERNATIVE AG-1 – NO FURTHER ACTION

No additional actions would be taken under Alternative AG-1. The cost estimate for Alternative AG-1 does not include any capital, O&M, or periodic costs.

3.3.2 ALTERNATIVE AG-2 – MONITORED NATURAL ATTENUATION (MNA)

Alternative AG-2 would include MNA. Long-term groundwater monitoring would be required to assess the progress of MNA in alluvial groundwater.

There would be no capital costs associated with Alternative AG-2. O&M costs would be associated with the implementation of monitoring and analysis. Annual O&M costs occur in Year 0 through 30. Periodic costs for the CERCLA 5-year review occur in Year 5, 10, 15, 20, 25 and 30.

3.3.3 ALTERNATIVE AG-3 – INSTITUTIONAL CONTROLS (ICS) AND MNA

Under Alternative AG-3, ICs (deed restrictions) would be put in place on Simplot-owned land in Sage Valley to prevent the use of alluvial groundwater with selenium concentrations above the MCL as a domestic water supply. Long-term groundwater monitoring would be required to assess the progress of MNA in alluvial groundwater.

The cost estimate for AG-3 includes development of an ICIAP, implementation of deed restrictions, and CERCLA 5-year reviews. O&M costs would include long-term groundwater monitoring. Capital costs occur in Year 0. O&M costs would occur in Years 0 through 30. Periodic costs occur in Years 5, 10, 15, 20, 25, and 30.

3.3.4 Alternative AG-4 – Permeable Reactive Barrier, ICs and MNA

Alternative AG-4 consists of a subsurface permeable reactive barrier (PRB) to treat water from the LP-1 seep. The PRB would consist of a trench excavated in the Pole Canyon Creek channel and aligned perpendicular to flow to intercept seep water at LP-1. The PRB would be filled with structural backfill (e.g., silica sand), a short-term carbon source (e.g., alfalfa hay or grass hay), and a long-term carbon source (e.g., wood chips) to passively treat contaminated seep water and alluvial groundwater using biodegradation. ICs under Alternative AG-4 would entail deed restrictions on Simplot-owned land in Sage Valley to prevent the use of shallow alluvial groundwater with selenium concentrations above the MCL as a domestic water supply. O&M and long-term groundwater monitoring would be required to evaluate the performance and effectiveness of the remedy, and the progress of MNA.

Capital costs for Alternative AG-4 include direct construction costs for the PRB, development of an ICIAP, implementation of deed restrictions and indirect construction costs for mobilization and demobilization and water and sediment control. Capital costs occur in Year 0. The cost estimate includes annual O&M costs for the PRB and for long-term groundwater monitoring. O&M costs occur in Years 0 through 30. The estimate includes periodic costs for carbon amendment and for reconstruction or media replacement, assuming the media will need to be replaced at that point, and for CERCLA 5-year reviews. Periodic costs for carbon amendment and media replacement occur every 10 years in Years 10, 20 and 30. Periodic costs for five-year reviews occur in Years 5, 10, 15, 20, 25, and 30.

3.4 Solids and Soils

As detailed in FSTM#2, the remedial alternatives for solids and soils are:

- Alternative S-1 – No Further Action
- Alternative S-2 – Rock Covers on Soils in Seep and Riparian Areas
- Alternative S-3 – 2-Foot Dinwoody or SLF Covers on Uncovered Areas of ODAs and Rock Covers on Soils in Seep and Riparian Areas
- Alternative S-4 –5-Foot Dinwoody or SLF/Chert Covers on Uncovered Areas of ODAs and Rock Covers on Soils in Seep and Riparian Areas

A summary of the present value estimates for these alternatives is presented in Table B-4. Detailed present value cost estimate information for Alternatives S-1, S-2, S-3 and S-4 are presented in Tables B-4a through B-4d, respectively. The itemized cost breakdown of these Alternatives is in Tables B-4e through B-4g. The remedial alternatives are briefly described, and key assumptions used in developing the cost estimate for each are summarized below.

3.4.1 Alternative S-1 – No Further Action

No additional actions would be taken under Alternative S-1. The cost estimate for Alternative S-1 does not include any capital, O&M, or periodic costs.

3.4.2 Alternative S-2 – Rock Covers on Soils in Seep and Riparian Areas

Alternative S-2 consists of rock covers of chert/limestone, or equivalent, that would be placed as a physical barrier layer on soils in overburden seep and riparian areas (DS-7, ES-4 and LP-1) and detention ponds (AP-3, DP-7, and EP-4) below ODAs to prevent terrestrial biota from contacting or ingesting soil with elevated selenium concentrations.

Capital costs for Alternative S-2 includes placement of the rock covers. Capital costs occur in Year 0. O&M costs include maintenance of the rock covers in Years 1 through 30. Periodic costs for the CERCLA 5-year reviews occur in Years 5, 10, 15, 20, 25, and 30.

3.4.3 Alternative S-3 – 2-Foot Dinwoody or SLF Covers on Uncovered Areas of ODAs and Rock Covers on Soil and Riparian Areas

Alternative S-3 consists of 2-foot Dinwoody or SLF covers that would be constructed over the 360-acre target area. The cover would be vegetated with native grass/forb species to control erosion. Stormwater run-on and runoff controls would be constructed to convey water off or around the backfilled pits and ODAs. ICs under Alternative S-3 would include grazing controls, land-use controls, and information programs. O&M would be required to maintain the effectiveness and permanence of the covers and stormwater controls.

Capital costs for Alternative S-3 include direct construction costs for the 2-foot thick Dinwoody cover, stormwater controls and ICs (grazing controls, land-use controls, and information programs), and indirect construction costs for mobilization and demobilization and water and sediment control. Capital costs occur in Years 0 through 2. The cost estimate includes annual O&M costs to maintain the effectiveness and permanence of the covers and components of the stormwater controls. Annual O&M costs begin in Year 3, after the completion of cover construction, and continue through Year 30. Periodic costs for the CERCLA 5-year review occur in Years 5, 10, 15, 20, 25, and 30.

3.4.4 Alternative S-4 – 5-Foot Dinwoody or SLF/Chert Covers on Uncovered Areas of ODAs and Rock Covers on Soils in Seep and Riparian Areas

Alternative S-4 would include construction of 5-Foot Dinwoody or SLF/chert covers on uncovered areas of Panels A and D. Under Alternative S-4, rock covers would be placed as a physical barrier on soils in overburden seep/riparian areas and ponds (DS-7, ES-4 and LP-1). O&M would be consistent with that described for Alternative S-3.

Capital costs for Alternative S-4 include direct construction costs for the 5-Foot Dinwoody or SLF/chert covers, stormwater controls and ICs (grazing controls, land-use controls, and information programs), and indirect construction costs for mobilization and demobilization and water and sediment control. Capital costs occur in Years 0 through 2. The cost estimate includes annual O&M costs to maintain the effectiveness and permanence of the covers and components of the stormwater controls. O&M costs occur in Years 3 through 30. Periodic costs for the CERCLA 5-year review occur in Years 5, 10, 15, 20, 25, and 30.

4 REFERENCES

Formation Environmental, LLC (Formation). 2014. Final Pilot Study Work Plan and Sampling and Analysis Plan, (Phase 1) Biological Selenium Removal Treatment Technology Fluidized Bed Bioreactor, and subsequent Addenda 01 through 04. Smoky Canyon Mine. Prepared for the J.R. Simplot Company. September.

Formation. 2017. Final Phase 2 Pilot Study Work Plan and Sampling and Analysis Plan, Ultra-Filtration/Reverse Osmosis and Biological Selenium Removal Fluidized Bed Bioreactor Treatment Technology, Smoky Canyon Mine Remedial Investigation/Feasibility Study. Prepared for J.R Simplot Company. March.

Means, RS. 2018. 2018 Heavy Construction Costs with RS Means Data 32nd Annual Edition.

United States Environmental Protection Agency (USEPA). 1988. Guidance for Conducting Remedial Investigation and Feasibility Studies Under CERCLA. Interim Final. EPA/540/G-89/004. October. https://semspub.epa.gov/work/06/901141.pdf

USEPA. 1996. The Role of Cost in the Superfund Remedy Selection Process. EPA 540/F-96/018. OSWER 9200.3-23FS. September. https://semspub.epa.gov/work/HQ/174446.pdf

USEPA. 2000. A Guide to Developing and Documenting Cost Estimates During the Feasibility Study. EPA 540R-00-002. OSWR 9355.0-75. July. https://semspub.epa.gov/work/HQ/174890.pdf

USEPA. 2003. Five-Year Review Process in the Superfund Program. EPA/540-F-02-004. OSWER 9355.7-09FS. April. https://semspub.epa.gov/work/HQ/174760.pdf

Table B-1
Wells Formation Groundwater Remedial Alternative Cost Summary (Present Value)

Cost Item Description	Alternative WG-1	Alternative WG-2	Alternative WG-3	Alternative WG-4	Alternative WG-5	Alternative WG-6	Alternative WG-7
Capital Costs	$0	$0	$50,000	$17,806,400	$29,662,300	$36,226,600	$66,476,800
Periodic Costs	$0	$215,800	$215,800	$215,800	$215,800	$215,800	$215,800
Annual O&M Costs	$0	$670,500	$670,500	$1,341,200	$1,341,200	$1,340,200	$3,826,700
Total Present Worth	**$0**	**$886,300**	**$936,300**	**$19,363,400**	**$31,219,300**	**$37,782,600**	**$70,519,300**

DRAFT
APRIL 2020

Table B-1a
Present Value of Alternative WG-1: No Further Action

Item	Notes	Start Year	End Year	Estimated Cost	Present Value[1]
Capital Costs					
N/A		0	0	$0	$0
Total				**$0**	**$0**
Annual O&M Costs					
N/A		0	0	$0	$0
Total				**$0**	**$0**
Periodic Costs					
N/A		0	0	$0	$0
Total				**$0**	**$0**
Net Present Value					**$0**

Notes

1 0.07 Interest rate used for Present Value

DRAFT

APRIL 2020

Table B-1b
Present Value of Alternative WG-2: Monitored Natural Attenuation

Item	Notes	Start Year	End Year	Estimated Cost	Present Value[1]
Capital Costs					
N/A		0	0	$0	$0
Total				**$0**	**$0**
Annual O&M Costs					
Groundwater Monitoring	a, c	0	30	$50,000	$670,500
Total				**$50,000**	**$670,500**
Periodic Costs					
5 Year Review	a, b	5	30	$100,000	$215,800
Total				**$100,000**	**$215,800**
Net Present Value					**$886,300**

Notes

1 0.07 Interest rate used for Present Value

a Present value calculated according to EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" Chapter 4

b Assumed level of effort for summarizing inspection findings, summarizing operation and maintenance activities completed, preparing presentation graphics for EPA lead 5-year review meetings

c Assuming 10 sampling locations being sampled by a 2-man crew. Includes field sampling activities, laboratory costs, (including QA/QC samples), data validation, data summary report preparation, and field sampling activities.

DRAFT

APRIL 2020

Table B-1c

Present Value of Alternative WG-3: Institutional Controls

Item	Notes	Start Year	End Year	Estimated Cost	Present Value[1]
Capital Costs					
Implementation	a, c	0	0	$50,000	$50,000
Total				**$50,000**	**$50,000**
O&M Costs					
Groundwater Monitoring	a, c	0	30	$50,000	$670,500
Total				**$50,000**	**$670,500**
Periodic Costs					
5 Year Review	a, b	5	30	$100,000	$215,800
Total				**$100,000**	**$215,800**
Net Present Value					**$936,300**

Notes

1 0.07 Interest rate used for Present Value

a Present value calculated according to EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" Chapter 4

b Assumed level of effort for summarizing inspection findings, summarizing operation and maintenance activities completed, preparing presentation graphics for EPA lead 5-year review meetings

c Based on cost for preparation of Institutional Control Implementation and Assurance Plan (ICIAP)

DRAFT

APRIL 2020

Table B-1d

Alternative WG-4

5-Foot Dinwoody or Salt Lake Formation/Chert Covers, ICs and MNA

Item	Notes	Start Year	End Year	Estimated Cost	Present Value[1]
Capital Costs					
Cover	a, c	0	1	$19,641,800	$17,756,400
Institutional Controls	e	0	0	$50,000	$50,000
Total				**$19,691,800**	**$17,806,400**
Annual O&M Costs					
Cover (Initial)	a	2	7	$131,000	$583,600
Cover (Subsequent)	a	8	30	$26,200	$183,900
Groundwater Monitoring	a, d	2	30	$50,000	$573,700
Total				**$76,200**	**$1,341,200**
Periodic Costs					
5 Year Review	a, b	5	30	$100,000	$215,800
Total				**$100,000**	**$215,800**
Net Present Value					**$19,363,400**

Notes

1 0.07 Interest rate used for Present Value

a Present value calculated according to EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" Chapter 4

b Assumed level of effort for summarizing inspection findings, summarizing operation and maintenance activities completed, preparing presentation graphics for EPA lead 5-year review meetings

c Based on time for Pole Canyon cover, which was approx. 1 field season. Scaled up/down based on acreage and cover type.

d Assuming 10 sampling locations being sampled by a 2-man crew. Includes field sampling activities, laboratory costs, (including QA/QC samples), data validation, data summary report preparation, and field sampling activities.

e Based on cost for preparation of Institutional Control Implementation and Assurance Plan (ICIAP)

DRAFT

APRIL 2020

Table B-1e

Alternative WG-5

Capillary Covers, ICs and MNA

Item	Notes	Start Year	End Year	Estimated Cost	Present Value[1]
<u>Capital Costs</u>					
Cover	a, c	0	1	$32,756,600	$29,612,300
Institutional Controls	e	0	0	$50,000	$50,000
Total				**$32,806,600**	**$29,662,300**
<u>Annual O&M Costs</u>					
Cover (Initial)	a	2	7	$131,000	$583,600
Cover (Subsequent)	a	8	30	$26,200	$183,900
Groundwater Monitoring	a, d	2	30	$50,000	$573,700
Total				**$207,200**	**$1,341,200**
<u>Periodic Costs</u>					
5 Year Review	a, b	5	30	$100,000	$215,800
Total				**$100,000**	**$215,800**
Net Present Value					**$31,219,300**

<u>Notes</u>

1 0.07 Interest rate used for Present Value

a Present value calculated according to EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" Chapter 4

b Assumed level of effort for summarizing inspection findings, summarizing operation and maintenance activities completed, preparing presentation graphics for EPA lead 5-year review meetings

c Based on time for Pole Canyon cover, which was approx. 1 field season. Scaled up/down based on acreage and cover type.

d Assuming 10 sampling locations being sampled by a 2-man crew. Includes field sampling activities, laboratory costs, (including QA/QC samples), data validation, data summary report preparation, and field sampling activities.

e Based on cost for preparation of Institutional Control Implementation and Assurance Plan (ICIAP)

DRAFT

APRIL 2020

Table B-1f

Alternative WG-6
Enhanced Dinwoody Covers,
ICs and MNA

Item	Notes	Start Year	End Year	Estimated Cost	Present Value[1]
Capital Costs					
Cover	a, c	0	5	$59,691,200	$36,176,600
Institutional Controls	e	0	0	$50,000	$50,000
Total				**$59,741,200**	**$36,226,600**
Annual O&M Costs					
Cover (Initial)	a	6	11	$196,400	$667,500
Cover (Subsequent)	a	12	30	$52,400	$257,300
Groundwater Monitoring	a, d	6	30	$50,000	$415,400
Total				**$102,400**	**$1,340,200**
Periodic Costs					
5 Year Review	a, b	5	30	$100,000	$215,800
Total				**$100,000**	**$215,800**
Net Present Value					**$37,782,600**

Notes

1 0.07 Interest rate used for Present Value

a Present value calculated according to EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" Chapter 4

b Assumed level of effort for summarizing inspection findings, summarizing operation and maintenance activities completed, preparing presentation graphics for EPA lead 5-year review meetings

c Based on time for Pole Canyon cover, which was approx. 1 field season. Scaled up/down based on acreage and cover type.

d Assuming 10 sampling locations being sampled by a 2-man crew. Includes field sampling activities, laboratory costs, (including QA/QC samples), data validation, data summary report preparation, and field sampling activities.

e Based on cost for preparation of Institutional Control Implementation and Assurance Plan (ICIAP)

DRAFT

APRIL 2020

Table B-1g
Alternative WG-7
Geomembrane Covers, ICs and MNA

Item	Notes	Start Year	End Year	Estimated Cost	Present Value[1]
Capital Costs					
Cover	a, c	0	1	$73,480,200	$66,426,800
Institutional Controls	e	0	0	$50,000	$50,000
Total				**$73,530,200**	**$66,476,800**
Annual O&M Costs					
Cover (Initial)	a	2	7	$523,800	$2,333,400
Cover (Subsequent)	a	8	30	$131,000	$919,600
Groundwater Monitoring	a, d	2	30	$50,000	$573,700
Total				**$181,000**	**$3,826,700**
Periodic Costs					
5 Year Review	a, b	5	30	$100,000	$215,800
Total				**$100,000**	**$215,800**
Net Present Value					**$70,519,300**

Notes

1 0.07 Interest rate used for Present Value

a Present value calculated according to EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" Chapter 4

b Assumed level of effort for summarizing inspection findings, summarizing operation and maintenance activities completed, preparing presentation graphics for EPA lead 5-year review meetings

c Based on time for Pole Canyon cover, which was approx. 1 field season. Scaled up/down based on acreage and cover type.

d Assuming 10 sampling locations being sampled by a 2-man crew. Includes field sampling activities, laboratory costs, (including QA/QC samples), data validation, data summary report preparation, and field sampling activities.

e Based on cost for preparation of Institutional Control Implementation and Assurance Plan (ICIAP)

DRAFT

APRIL 2020

Table B-1h

Alternative WG-4 Cost Breakdown

5-Foot Dinwoody or Salt Lake Formation/Chert Covers

Item	Notes	Quantity	Unit	Cost/Acre	Total Cost
Capital Costs					
PREPARE SLOPE FOR COVER					
Regrade/Compact/Strip	e			$1,000	
3rd Party Survey/CQC/Design	e			$1,000	
PREPARE MATERIALS					
Construct Haul Road to DW/SLF/Topsoil Borrows	e			$15,009	
Haul Loose Dinwoody to Project Area	e			$13,310	
Haul Topsoil to Project Area	e			$13,310	
MISC. LAYERS					
2-Ft CH for Deep Dinwoody	e			$6,500	
2-FT Dinwoody/SLF (Loose)	e			$6,000	
VEGETATION					
Seeding and Fertilizer	e			$4,000	
Bonded Fiber Matrix Hydromulch	e			$1,500	
EROSION CONTROL					
Purchase and Install Silt Fence	e			$200	
Purchase and Install Wattles	e			$2,000	
MOBILIZATION/DEMOBILIZATION					
Equipment Mobilization and Training	e			$250	
Total Cost Per Acre				$64,100	
Acreage	a	194	acre		
Total					**$12,435,400**
Construction Subtotal					**$12,435,400**
Contingency	b	10% Scope + 25% Bid			$4,352,400
Subtotal					**$16,787,800**
Remedial Design	c	6%			$1,007,300
Project/Construction Management	c	11%			$1,846,700
Total					$2,854,000
Total Capital Costs					**$19,641,800**
Initial Annual O&M Costs					
O&M Costs	a, f	194	acre	$500	$97,000
Contingency	d	35%			$34,000
Total Initial Annual O&M Costs					**$131,000**
Subsequent Annual O&M Costs					
O&M Costs	a, f	194	acre	$100	$19,400
Contingency	d	35%			$6,800
Total Subsequent Annual O&M Costs					**$26,200**
Periodic Costs					**$0**
Total Periodic Costs					**$0**

Notes

[a] Acreage calculated using GIS

[b] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Page 5-11 and Exhibit 5-6

[c] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Exhibit 5-8

[d] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Chapter 5

[e] Costs provided by Simplot

f Based on Pole Canyon cost estimates

DRAFT

APRIL 2020

Table B-1i

Alternative WG-5
Capillary Covers, MNA and ICs

Item	Notes	Quantity	Unit	Cost/Acre	Total Cost
Capital Costs					
PREPARE SLOPE FOR COVER SYSTEM					
Regrade/Compact/Strip	e			$3,500	
3rd Party Survey/CQC/Design	e			$5,000	
PREPARE MATERIALS					
Construct Haul Road to DW/SLF/Topsoil Borrows	e			$15,009	
Process and Stockpile Drainage Material (1" x 4")	e			$14,850	
Haul Core Material for Drainage Benches to Stockpile	e			$8,640	
Haul Loose Dinwoody to Project Area	e			$19,965	
Purchase and Install Geotextile for Filter Fabric	e			$10,000	
MISC. LAYERS					
2-Ft CH for Deep Dinwoody	e			$6,500	
2-FT Dinwoody/SLF (Loose)	e			$6,000	
SCREENED DINWOODY LAYER					
Haul, Place, and Compact 6-inch screened dinwoody	e			$4,000	
DRAINAGE SYSTEM					
Haul (from stockpile), Place, and Compact Core Material for Drainage Benches	e			$2,000	
Haul and Place drainage material for Drainage Benches	e			$2,000	
Install D50 6-inch Riprap in Drainage Benches	e			$500	
Excavate and grade outlet ponds	e			$750	
Install D50 6-inch Riprap in outlet ponds	e			$250	
VEGETATION					
Seeding and Fertilizer	e			$4,000	
Bonded Fiber Matrix Hydromulch	e			$1,500	
EROSION CONTROL					
Purchase and Install Silt Fence	e			$200	
Purchase and Install Wattles	e			$2,000	
MOBILIZATION/DEMOBILIZATION					
Equipment Mobilization and Training	e			$250	
Total Cost Per Acre				$106,900	
Acreage	a	194	acre		
Total					**$20,738,600**
Construction Subtotal					**$20,738,600**
Contingency	b	10% Scope + 25% Bid			$7,258,500
Subtotal					**$27,997,100**
Remedial Design	c	6%			$1,679,800
Project/Construction Management	c	11%			$3,079,700
Total					$4,759,500
Total Capital Costs					**$32,756,600**
Initial Annual O&M Costs					
O&M Costs	a, f	194	acre	$500	$97,000
Contingency	d	35%			$34,000
Total Initial Annual O&M Costs					**$131,000**
Subsequent Annual O&M Costs					
O&M Costs	a, f	194	acre	$100	$19,400
Contingency	d	35%			$6,800
Total Subsequent Annual O&M Costs					**$26,200**
Periodic Costs					**$0**
Total Periodic Costs					**$0**

Notes

[a] Acreage calculated using GIS

[b] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Page 5-11 and Exhibit 5-6

[c] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Exhibit 5-8

[d] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Chapter 5

[e] Costs provided by Simplot

[f] Based on Pole Canyon cost estimates

DRAFT

APRIL 2020

Table B-1j
Alternative WG-6 Enhanced Dinwoody Covers, MNA and ICs

Item	Notes	Quantity	Unit	Cost/Acre	Total Cost
Capital Costs					
PREPARE SLOPE FOR COVER SYSTEM					
Regrade/Compact/Strip	e			$3,500	
3rd Party Survey/CQC/Design	e			$15,000	
PREPARE MATERIALS					
Construct Haul Road to DW/SLF/Topsoil Borrows	e			$15,009	
Process and Stockpile Drainage Material (1" x 4")	e			$22,500	
Process and Stockpile D50 6-inch Riprap (4" to 9")	e			$1,500	
Haul Core Material for Drainage Benches to Stockpile	e			$7,200	
Haul Loose Dinwoody to Project Area	e			$35,493	
Haul Topsoil to Project Area	e			$13,310	
Purchase Geomembrane for Drainage Ditch	e			$4,500	
Purchase and Install Geotextile for Filter Fabric	e			$10,000	
SCREENED DINWOODY LAYER					
Screen Dinwoody	e			$4,000	
Haul, Place, and Compact 6-inch screened dinwoody	e			$4,000	
ENHANCED DINWOODY LAYER					
Screen Dinwoody, Pugmill Mix Bentonite into Screened Dinwoody	e			$16,500	
Purchase Bentonite (@ 7%)	e			$6,000	
Haul Bentonite	e			$6,500	
Haul, Place, and Compact 6-inch amended dinwoody	e			$4,000	
DRAINAGE LAYER					
Haul and Place 18-inch Drainage Layer	e			$5,000	
LOOSE DINWOODY LAYER					
Haul and Place 24-inch Loose Dinwoody	e			$4,800	
TOPSOIL LAYER					
Haul and Place 12-inch Topsoil layer	e			$2,500	
DRAINAGE SYSTEM					
Haul (from stockpile), Place, and Compact Core Material for Drainage Benches	e			$2,000	
Haul and Place drainage material for Drainage Benches	e			$2,000	
Install D50 6-inch Riprap in Drainage Benches	e			$500	
Excavate and grade outlet ponds	e			$750	
Install D50 6-inch Riprap in outlet ponds	e			$250	
VEGETATION					
Seeding and Fertilizer	e			$4,000	
Bonded Fiber Matrix Hydromulch	e			$1,500	
EROSION CONTROL					
Purchase and Install Silt Fence	e			$200	
Purchase and Install Wattles	e			$2,000	
MOBILIZATION/DEMOBILIZATION					
Equipment Mobilization and Training	e			$250	
Total Cost Per Acre				$194,800	
Acreage	a	194	acre		
Total					**$37,791,200**
Construction Subtotal					**$37,791,200**
Contingency	b	10% Scope + 25% Bid			$13,226,900
Subtotal					**$51,018,100**
Remedial Design	c	6%			$3,061,100
Project/Construction Management	c	11%			$5,612,000
Total					$8,673,100
Total Capital Costs					**$59,691,200**
Initial Annual O&M Costs					
O&M Costs	a, f	194	acre	$750	$145,500
Contingency	d	35%			$50,900
Total Initial Annual O&M Costs					**$196,400**
Subsequent Annual O&M Costs					
O&M Costs	a, f	194	acre	$200	$38,800
Contingency	d	35%			$13,600
Total Subsequent Annual O&M Costs					**$52,400**
Periodic Costs					**$0**
Total Periodic Costs					**$0**

Notes

[a] Acreage calculated using GIS

[b] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Page 5-11 and Exhibit 5-6

[c] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Exhibit 5-8

[d] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Chapter 5

[e] Costs provided by Simplot

[f] Based on Pole Canyon cost estimates

DRAFT

APRIL 2020

Table B-1k

Alternative WG-7

Geomembrane Covers, MNA and ICs

Item	Notes	Quantity	Unit	Cost/Acre	Total Cost
Capital Costs					
PREPARE SLOPE FOR COVER SYSTEM					
Regrade/Compact/Strip	e			$4,500	
3rd Party Survey/CQC/Design	e			$15,000	
PREPARE MATERIALS					
Construct Haul Road to DW/SLF/Topsoil Borrows	e			$15,009	
Process and Stockpile Drainage Material (1" x 4")	e			$22,500	
Process and Stockpile D50 6-inch Riprap (4" to 9")	e			$1,500	
Haul Core Material for Drainage Benches to Stockpile	e			$7,200	
Haul Loose Dinwoody to Project Area	e			$19,965	
Haul Topsoil to Project Area	e			$13,310	
Purchase Geomembrane for Drainage Ditch	e			$4,500	
Purchase and Install Geotextile for Filter Fabric	e			$10,000	
MISC. LAYERS					
GCLL Purchase and Install	e			$52,577	
Geocomposite Purchase and Install	e			$52,953	
LOOSE DINWOODY LAYER					
Haul and Place 24-inch Loose Dinwoody	e			$4,799	
TOPSOIL LAYER					
Haul and Place 12-inch Topsoil layer	e			$2,500	
DRAINAGE SYSTEM					
Haul (from stockpile), Place, and Compact Core Material for Drainage Benches	e			$1,999	
Haul and Place drainage material for Drainage Benches	e			$2,000	
Install D50 6-inch Riprap in Drainage Benches	e			$500	
Excavate and grade outlet ponds	e			$750	
Install D50 6-inch Riprap in outlet ponds	e			$250	
VEGETATION					
Seeding and Fertilizer	e			$4,000	
Bonded Fiber Matrix Hydromulch	e			$1,500	
EROSION CONTROL					
Purchase and Install Silt Fence	e			$200	
Purchase and Install Wattles	e			$2,000	
MOBILIZATION/DEMOBILIZATION					
Equipment Mobilization and Training	e			$250	
Total Cost Per Acre				$239,800	
Acreage	a	194	acre		
Total					**$46,521,200**
Construction Subtotal					**$46,521,200**
Contingency	b	10% Scope + 25% Bid			$16,282,400
Subtotal					**$62,803,600**
Remedial Design	c	6%			$3,768,200
Project/Construction Management	c	11%			$6,908,400
Total					$10,676,600
Total Capital Costs					**$73,480,200**
Initial Annual O&M Costs					
O&M Costs	a, f	194	acre	$2,000	$388,000
Contingency	d	35%			$135,800
Total Initial Annual O&M Costs					**$523,800**
Subsequent Annual O&M Costs					
O&M Costs	a, f	194	acre	$500	$97,000
Contingency	d	35%			$34,000
Total Subsequent Annual O&M Costs					**$131,000**
Periodic Costs					**$0**
Total Periodic Costs					**$0**

Notes

a Acreage calculated using GIS

b Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Page 5-11 and Exhibit 5-6

c Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Exhibit 5-8

d Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Chapter 5

e Costs provided by Simplot

f Based on Pole Canyon cost estimates

DRAFT

APRIL 2020

TABLE B-13. SURFACE WATER REMEDIAL ALTERNATIVE COST SUMMARY

TABLE B-14A. PRESENT VALUE OF ALTERNATIVE SW-1: NO FURTHER ACTION

TABLE B-15B. PRESENT VALUE OF ALTERNATIVE SW-2: 5-FOOT DINWOODY OR SALT LAKE FORMATION/CHERT COVERS

TABLE B-16C. PRESENT VALUE OF ALTERNATIVE SW-3: CAPILLARY COVERS

TABLE B-17D. PRESENT VALUE OF ALTERNATIVE SW-4: ENHANCED DINWOODY COVERS

TABLE B-18E. PRESENT VALUE OF ALTERNATIVE SW-5: GEOMEMBRANE COVERS

TABLE B-19F. PRESENT VALUE OF ALTERNATIVE SW-6A: TREATMENT OF WATER DISCHARGING AT HOOPES SPRING (2,000 GPM)

TABLE B-20G. PRESENT VALUE OF ALTERNATIVE SW-6B: TREATMENT OF WATER DISCHARGING AT HOOPES SPRING (3,000 GPM)

TABLE B-21H. COST BREAKDOWN OF ALTERNATIVE SW-2: 5-FOOT DINWOODY OR SALT LAKE FORMATION/CHERT COVERS

TABLE B-22I. COST BREAKDOWN OF ALTERNATIVE SW-3: CAPILLARY COVERS

TABLE B-23J. COST BREAKDOWN OF ALTERNATIVE SW-4: ENHANCED DINWOODY COVERS

TABLE B-24K. COST BREAKDOWN OF ALTERNATIVE SW-5: GEOMEMBRANE COVERS

TABLE B-25L. COST BREAKDOWN OF ALTERNATIVE SW-6A: TREATMENT OF WATER DISCHARGING AT HOOPES SPRING (2,000 GPM)

TABLE B-26M. COST BREAKDOWN OF ALTERNATIVE SW-6B: TREATMENT OF WATER DISCHARGING AT HOOPES SPRING (3,000 GPM)

TABLE B-2N. COST BREAKDOWN FOR CONSTRUCTION OF PHYSICAL BARRIERS

Table B-2
Surface Water Remedial Alternative Cost Summary (Present Value)

Cost Item Description	Alternative SW-1	Alternative SW-2	Alternative SW-3	Alternative SW-4	Alternative SW-5	Alternative SW-6a	Alternative SW-6
Capital Costs	$0	$17,795,100	$29,651,000	$36,215,300	$66,465,500	$38,262,600	$67,799,300
Periodic Costs	$0	$215,800	$215,800	$215,800	$215,800	$216,000	$216,000
Annual O&M Costs	$0	$1,358,600	$1,358,600	$1,357,600	$3,844,100	$27,791,200	$41,367,900
Total Present Worth	**$0**	**$19,369,500**	**$31,225,400**	**$37,788,700**	**$70,525,400**	**$66,269,800**	**$109,383,200**

DRAFT

APRIL 2020

Table B-2a
Present Value of Alternative SW-1: No Further Action

Item	Notes	Start Year	End Year	Estimated Cost	Present Value[1]
Capital Costs					
N/A		0	0	$0	$0
Total				**$0**	**$0**
Annual O&M Costs					
N/A		0	0	$0	$0
Total				**$0**	**$0**
Periodic Costs					
N/A		0	0	$0	$0
Total				**$0**	**$0**
Net Present Value					**$0**

Notes

1 0.07 Interest rate used for Present Value

DRAFT

APRIL 2020

Table B-2b

Alternative SW-2

5-Foot Dinwoody or Salt Lake Formation/Chert Covers

Item	Notes	Start Year	End Year	Estimated Cost	Present Value[1]
Capital Costs					
Cover	a, c	0	1	$19,641,800	$17,756,400
Physical Barriers	a	0	0	$38,700	$38,700
Total				**$19,680,500**	**$17,795,100**
Annual O&M Costs					
Cover (Intitial)	a	2	7	$131,000	$583,600
Cover (Subsquent)	a	8	30	$26,200	$183,900
Physical Barriers	a	1	30	$1,400	$17,400
Surface Water Monitoring	a, d	2	30	$50,000	$573,700
Total				**$77,600**	**$1,358,600**
Periodic Costs					
5 Year Review	a, b	5	30	$100,000	$215,800
Total				**$100,000**	**$215,800**
Net Present Value					**$19,369,500**

Notes

1 0.07 Interest rate used for Present Value

a Present value calculated according to EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" Chapter 4

b Assumed level of effort for summarizing inspection findings, summarizing operation and maintenance activities completed, preparing presentation graphics for EPA lead 5-year review meetings

c Based on time for Pole Canyon cover, which was approx. 1 field season. Scaled up/down based on acreage and cover type.

d Assuming 10 sampling locations being sampled by a 2-man crew. Includes field sampling activities, laboratory costs, (including QA/QC samples), data validation, data summary report preparation, and field sampling activities.

e Based on cost for preparation of Institutional Control Implementation and Assurance Plan (ICIAP)

DRAFT

APRIL 2020

Table B-2c

Alternative SW-3

Capillary Covers

Item	Notes	Start Year	End Year	Estimated Cost	Present Value[1]
Capital Costs					
Cover	a, c	0	1	$32,756,600	$29,612,300
Physical Barriers	a	0	0	$38,700	$38,700
Total				**$32,795,300**	**$29,651,000**
Annual O&M Costs					
Cover (Intitial)	a	2	7	$131,000	$583,600
Cover (Subsquent)	a	8	30	$26,200	$183,900
Physical Barriers	a	1	30	$1,400	$17,400
Surface Water Monitoring	a, d	2	30	$50,000	$573,700
Total				**$77,600**	**$1,358,600**
Periodic Costs					
5 Year Review	a, b	5	30	$100,000	$215,800
Total				**$100,000**	**$215,800**
Net Present Value					**$31,225,400**

Notes

1 0.07 Interest rate used for Present Value

a Present value calculated according to EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" Chapter 4

b Assumed level of effort for summarizing inspection findings, summarizing operation and maintenance activities completed, preparing presentation graphics for EPA lead 5-year review meetings

c Based on time for Pole Canyon cover, which was approx. 1 field season. Scaled up/down based on acreage and cover type.

d Assuming 10 sampling locations being sampled by a 2-man crew. Includes field sampling activities, laboratory costs, (including QA/QC samples), data validation, data summary report preparation, and field sampling activities.

DRAFT

APRIL 2020

Table B-2d

Alternative SW-4
Enhanced Dinwoody Covers

Item	Notes	Start Year	End Year	Estimated Cost	Present Value[1]
Capital Costs					
Cover	a, c	0	5	$59,691,200	$36,176,600
Physical Barriers	a	0	0	$38,700	$38,700
Total				**$59,729,900**	**$36,215,300**
Annual O&M Costs					
Cover (Intitial)	a	6	11	$196,400	$667,500
Cover (Subsquent)	a	12	30	$52,400	$257,300
Physical Barriers	a	1	30	$1,400	$17,400
Surface Water Monitoring	a, d	6	30	$50,000	$415,400
Total				**$103,800**	**$1,357,600**
Periodic Costs					
5 Year Review	a, b	5	30	$100,000	$215,800
Total				**$100,000**	**$215,800**
Net Present Value					**$37,788,700**

Notes

1 0.07 Interest rate used for Present Value

a Present value calculated according to EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" Chapter 4

b Assumed level of effort for summarizing inspection findings, summarizing operation and maintenance activities completed, preparing presentation graphics for EPA lead 5-year review meetings

c Based on time for Pole Canyon cover, which was approx. 1 field season. Scaled up/down based on acreage and cover type.

d Assuming 10 sampling locations being sampled by a 2-man crew. Includes field sampling activities, laboratory costs, (including QA/QC samples), data validation, data summary report preparation, and field sampling activities.

DRAFT

APRIL 2020

Table B-2e
Alternative SW-5
Geomembrane Covers

Item	Notes	Start Year	End Year	Estimated Cost	Present Value[1]
Capital Costs					
Cover	a, c	0	1	$73,480,200	$66,426,800
Physical Barriers	a	0	0	$38,700	$38,700
Total				**$73,518,900**	**$66,465,500**
Annual O&M Costs					
Cover (Intitial)	a	2	7	$523,800	$2,333,400
Cover (Subsquent)	a	8	30	$131,000	$919,600
Physical Barriers	a	1	30	$1,400	$17,400
Surface Water Monitoring	a, d	2	30	$50,000	$573,700
Total				**$182,400**	**$3,844,100**
Periodic Costs					
5 Year Review	a, b	5	30	$100,000	$215,800
Total				**$100,000**	**$215,800**
Net Present Value					**$70,525,400**

Notes

1 0.07 Interest rate used for Present Value

a Present value calculated according to EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" Chapter 4

b Assumed level of effort for summarizing inspection findings, summarizing operation and maintenance activities completed, preparing presentation graphics for EPA lead 5-year review meetings

c Based on time for Pole Canyon cover, which was approx. 1 field season. Scaled up/down based on acreage and cover type.

d Assuming 10 sampling locations being sampled by a 2-man crew. Includes field sampling activities, laboratory costs, (including QA/QC samples), data validation, data summary report preparation, and field sampling activities.

DRAFT

APRIL 2020

Table B-2f

Present Value of Alternative SW-6a: Water Treatment at Hoopes Springs (2,000 gpm)

Item	Notes	Start Year	End Year	Estimated Cost	Present Value
Capital Costs					
WTP	a	0	0	$38,223,900	$38,223,900
Physical Barriers	a	0	0	$38,700	$38,700
Total				**$38,262,600**	**$38,262,600**
O&M Costs					
WTP	a	0	30	$2,025,000	$27,153,300
Physical Barriers	a	1	30	$1,400	$17,400
Surface Water Monitoring	a, c	1	30	$50,000	$620,500
Total				**$2,076,400**	**$27,791,200**
Periodic Costs					
5 Year Review	a, b	5	30	$100,000	$216,000
Total				**$100,000**	**$216,000**
Net Present Value					**$66,269,800**

Notes

1 0.07 Interest rate used for Present Value

a Present value calculated according to EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" Chapter 4

b Assumed level of effort for summarizing inspection findings, summarizing operation and maintenance activities completed, preparing presentation graphics for EPA lead 5-year review meetings

c Assuming 10 sampling locations being sampled by a 2-man crew. Includes field sampling activities, laboratory costs, (including QA/QC samples), data validation, data summary report preparation, and field sampling activities.

DRAFT

APRIL 2020

Table B-2g
Present Value of Alternative SW-6b: Water Treatment at Hoopes Springs (3,000 gpm)

Item	Notes	Start Year	End Year	Estimated Cost	Present Value
Capital Costs					
WTP	a	0	0	$67,760,550	$67,760,600
Physical Barriers	a	0	0	$38,700	$38,700
Total				**$67,799,250**	**$67,799,300**
O&M Costs					
WTP	a	0	30	$3,037,500	$40,730,000
Physical Barriers	a	1	30	$1,400	$17,400
Surface Water Monitoring	a, c	1	30	$50,000	$620,500
Total				**$3,088,900**	**$41,367,900**
Periodic Costs					
5 Year Review	a, b	5	30	$100,000	$216,000
Total				**$100,000**	**$216,000**
Net Present Value					**$109,383,200**

Notes

1 0.07 Interest rate used for Present Value

a Present value calculated according to EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" Chapter 4

b Assumed level of effort for summarizing inspection findings, summarizing operation and maintenance activities completed, preparing presentation graphics for EPA lead 5-year review meetings

c Assuming 10 sampling locations being sampled by a 2-man crew. Includes field sampling activities, laboratory costs, (including QA/QC samples), data validation, data summary report preparation, and field sampling activities.

DRAFT

APRIL 2020

Table B-2h
Alternative SW-2
5-Foot Dinwoody or Salt Lake Formation/Chert Covers

Item	Notes	Quantity	Unit	Cost/Acre	Total Cost
Capital Costs					
PREPARE SLOPE FOR COVER					
Regrade/Compact/Strip	e			$1,000	
3rd Party Survey/CQC/Design	e			$1,000	
PREPARE MATERIALS					
Construct Haul Road to DW/SLF/Topsoil Borrows	e			$15,009	
Haul Loose Dinwoody to Project Area	e			$13,310	
Haul Topsoil to Project Area	e			$13,310	
MISC. LAYERS					
2-Ft CH for Deep Dinwoody	e			$6,500	
2-FT Dinwoody/SLF (Loose)	e			$6,000	
VEGETATION					
Seeding and Fertilizer	e			$4,000	
Bonded Fiber Matrix Hydromulch	e			$1,500	
EROSION CONTROL					
Purchase and Install Silt Fence	e			$200	
Purchase and Install Wattles	e			$2,000	
MOBILIZATION/DEMOBILIZATION					
Equipment Mobilization and Training	e			$250	
Total Cost Per Acre				$64,100	
Acreage	a	194	acre		
Total					**$12,435,400**
Construction Subtotal					**$12,435,400**
Contingency	b	10% Scope + 25% Bid			$4,352,400
Subtotal					**$16,787,800**
Remedial Design	c	6%			$1,007,300
Project/Construction Management	c	11%			$1,846,700
Total					$2,854,000
Total Capital Costs					**$19,641,800**
Initial Annual O&M Costs					
O&M Costs	a, f	194	acre	$500	$97,000
Contingency	d	35%			$34,000
Total Initial Annual O&M Costs					**$131,000**
Subsequent Annual O&M Costs					
O&M Costs	a, f	194	acre	$100	$19,400
Contingency	d	35%			$6,800
Total Subsequent Annual O&M Costs					**$26,200**
Periodic Costs					**$0**
Total Periodic Costs					**$0**

Notes

[a] Acreage calculated using GIS
[b] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Page 5-11 and Exhibit 5-6
[c] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Exhibit 5-8
[d] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Chapter 5
[e] Costs provided by Simplot
[f] Based on Pole Canyon cost estimates

DRAFT
APRIL 2020

Table B-2i
Alternative SW-3 Capillary Covers, MNA and ICs

Item	Notes	Quantity	Unit	Cost/Acre	Total Cost
Capital Costs					
PREPARE SLOPE FOR COVER SYSTEM					
Regrade/Compact/Strip	e			$3,500	
3rd Party Survey/CQC/Design	e			$5,000	
PREPARE MATERIALS					
Construct Haul Road to DW/SLF/Topsoil Borrows	e			$15,009	
Process and Stockpile Drainage Material (1" x 4")	e			$14,850	
Haul Core Material for Drainage Benches to Stockpile	e			$8,640	
Haul Loose Dinwoody to Project Area	e			$19,965	
Purchase and Install Geotextile for Filter Fabric	e			$10,000	
MISC. LAYERS					
2-Ft CH for Deep Dinwoody	e			$6,500	
2-FT Dinwoody/SLF (Loose)	e			$6,000	
SCREENED DINWOODY LAYER					
Haul, Place, and Compact 6-inch screened dinwoody	e			$4,000	
DRAINAGE SYSTEM					
Haul (from stockpile), Place, and Compact Core Material for Drainage Benches	e			$2,000	
Haul and Place drainage material for Drainage Benches	e			$2,000	
Install D50 6-inch Riprap in Drainage Benches	e			$500	
Excavate and grade outlet ponds	e			$750	
Install D50 6-inch Riprap in outlet ponds	e			$250	
VEGETATION					
Seeding and Fertilizer	e			$4,000	
Bonded Fiber Matrix Hydromulch	e			$1,500	
EROSION CONTROL					
Purchase and Install Silt Fence	e			$200	
Purchase and Install Wattles	e			$2,000	
MOBILIZATION/DEMOBILIZATION					
Equipment Mobilization and Training	e			$250	
Total Cost Per Acre				$106,900	
Acreage	a	194	acre		
Total					**$20,738,600**
Construction Subtotal					**$20,738,600**
Contingency	b	10% Scope + 25% Bid			$7,258,500
Subtotal					**$27,997,100**
Remedial Design	c	6%			$1,679,800
Project/Construction Management	c	11%			$3,079,700
Total					$4,759,500
Total Capital Costs					**$32,756,600**
Initial Annual O&M Costs					
O&M Costs	a, f	194	acre	$500	$97,000
Contingency	d	35%			$34,000
Total Initial Annual O&M Costs					**$131,000**
Subsequent Annual O&M Costs					
O&M Costs	a, f	194	acre	$100	$19,400
Contingency	d	35%			$6,800
Total Subsequent Annual O&M Costs					**$26,200**
Periodic Costs					**$0**
Total Periodic Costs					**$0**

Notes

a Acreage calculated using GIS
b Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Page 5-11 and Exhibit 5-6
c Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Exhibit 5-8
d Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Chapter 5
e Costs provided by Simplot
f Based on Pole Canyon cost estimates

DRAFT
APRIL 2020

Table B-2j
Alternative SW-4 Enhanced Dinwoody Covers, MNA and ICs

Item	Notes	Quantity	Unit	Cost/Acre	Total Cost
Capital Costs					
PREPARE SLOPE FOR COVER SYSTEM					
Regrade/Compact/Strip	e			$3,500	
3rd Party Survey/CQC/Design	e			$15,000	
PREPARE MATERIALS					
Construct Haul Road to DW/SLF/Topsoil Borrows	e			$15,009	
Process and Stockpile Drainage Material (1" x 4")	e			$22,500	
Process and Stockpile D50 6-inch Riprap (4" to 9")	e			$1,500	
Haul Core Material for Drainage Benches to Stockpile	e			$7,200	
Haul Loose Dinwoody to Project Area	e			$35,493	
Haul Topsoil to Project Area	e			$13,310	
Purchase Geomembrane for Drainage Ditch	e			$4,500	
Purchase and Install Geotextile for Filter Fabric	e			$10,000	
SCREENED DINWOODY LAYER					
Screen Dinwoody	e			$4,000	
Haul, Place, and Compact 6-inch screened dinwoody	e			$4,000	
ENHANCED DINWOODY LAYER					
Screen Dinwoody, Pugmill Mix Bentonite into Screened Dinwoody	e			$16,500	
Purchase Bentonite (@ 7%)	e			$6,000	
Haul Bentonite	e			$6,500	
Haul, Place, and Compact 6-inch amended dinwoody	e			$4,000	
DRAINAGE LAYER					
Haul and Place 18-inch Drainage Layer	e			$5,000	
LOOSE DINWOODY LAYER					
Haul and Place 24-inch Loose Dinwoody	e			$4,800	
TOPSOIL LAYER					
Haul and Place 12-inch Topsoil layer	e			$2,500	
DRAINAGE SYSTEM					
Haul (from stockpile), Place, and Compact Core Material for Drainage Benches	e			$2,000	
Haul and Place drainage material for Drainage Benches	e			$2,000	
Install D50 6-inch Riprap in Drainage Benches	e			$500	
Excavate and grade outlet ponds	e			$750	
Install D50 6-inch Riprap in outlet ponds	e			$250	
VEGETATION					
Seeding and Fertilizer	e			$4,000	
Bonded Fiber Matrix Hydromulch	e			$1,500	
EROSION CONTROL					
Purchase and Install Silt Fence	e			$200	
Purchase and Install Wattles	e			$2,000	
MOBILIZATION/DEMOBILIZATION					
Equipment Mobilization and Training	e			$250	
Total Cost Per Acre				$194,800	
Acreage	a	194	acre		
Total					**$37,791,200**
Construction Subtotal					**$37,791,200**
Contingency	b	10% Scope + 25% Bid			$13,226,900
Subtotal					**$51,018,100**
Remedial Design	c	6%			$3,061,100
Project/Construction Management	c	11%			$5,612,000
Total					$8,673,100
Total Capital Costs					**$59,691,200**
Initial Annual O&M Costs					
O&M Costs	a, f	194	acre	$750	$145,500
Contingency	d	35%			$50,900
Total Initial Annual O&M Costs					**$196,400**
Subsequent Annual O&M Costs					
O&M Costs	a, f	194	acre	$200	$38,800
Contingency	d	35%			$13,600
Total Subsequent Annual O&M Costs					**$52,400**
Periodic Costs					**$0**
Total Periodic Costs					**$0**

Notes

[a] Acreage calculated using GIS
[b] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Page 5-11 and Exhibit 5-6
[c] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Exhibit 5-8
[d] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Chapter 5
[e] Costs provided by Simplot
[f] Based on Pole Canyon cost estimates

DRAFT
APRIL 2020

Table B-2k

Alternative SW-5
Geomembrane Covers, MNA and ICs

Item	Notes	Quantity	Unit	Cost/Acre	Total Cost
Capital Costs					
PREPARE SLOPE FOR COVER SYSTEM					
Regrade/Compact/Strip	e			$4,500	
3rd Party Survey/CQC/Design	e			$15,000	
PREPARE MATERIALS					
Construct Haul Road to DW/SLF/Topsoil Borrows	e			$15,009	
Process and Stockpile Drainage Material (1" x 4")	e			$22,500	
Process and Stockpile D50 6-inch Riprap (4" to 9")	e			$1,500	
Haul Core Material for Drainage Benches to Stockpile	e			$7,200	
Haul Loose Dinwoody to Project Area	e			$19,965	
Haul Topsoil to Project Area	e			$13,310	
Purchase Geomembrane for Drainage Ditch	e			$4,500	
Purchase and Install Geotextile for Filter Fabric	e			$10,000	
MISC. LAYERS					
GCLL Purchase and Install	e			$52,577	
Geocomposite Purchase and Install	e			$52,953	
LOOSE DINWOODY LAYER					
Haul and Place 24-inch Loose Dinwoody	e			$4,799	
TOPSOIL LAYER					
Haul and Place 12-inch Topsoil layer	e			$2,500	
DRAINAGE SYSTEM					
Haul (from stockpile), Place, and Compact Core Material for Drainage Benches	e			$1,999	
Haul and Place drainage material for Drainage Benches	e			$2,000	
Install D50 6-inch Riprap in Drainage Benches	e			$500	
Excavate and grade outlet ponds	e			$750	
Install D50 6-inch Riprap in outlet ponds	e			$250	
VEGETATION					
Seeding and Fertilizer	e			$4,000	
Bonded Fiber Matrix Hydromulch	e			$1,500	
EROSION CONTROL					
Purchase and Install Silt Fence	e			$200	
Purchase and Install Wattles	e			$2,000	
MOBILIZATION/DEMOBILIZATION					
Equipment Mobilization and Training	e			$250	
Total Cost Per Acre				$239,800	
Acreage	a	194	acre		
Total					**$46,521,200**
Construction Subtotal					**$46,521,200**
Contingency	b	10% Scope + 25% Bid			$16,282,400
Subtotal					**$62,803,600**
Remedial Design	c	6%			$3,768,200
Project/Construction Management	c	11%			$6,908,400
Total					$10,676,600
Total Capital Costs					**$73,480,200**
Initial Annual O&M Costs					
O&M Costs	a, f	194	acre	$2,000	$388,000
Contingency	d	35%			$135,800
Total Initial Annual O&M Costs					**$523,800**
Subsequent Annual O&M Costs					
O&M Costs	a, f	194	acre	$500	$97,000
Contingency	d	35%			$34,000
Total Subsequent Annual O&M Costs					**$131,000**
Periodic Costs					**$0**
Total Periodic Costs					**$0**

Notes

[a] Acreage calculated using GIS
[b] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Page 5-11 and Exhibit 5-6
[c] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Exhibit 5-8
[d] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Chapter 5
[e] Costs provided by Simplot
[f] Based on Pole Canyon cost estimates

DRAFT
APRIL 2020

Table B-2l
SW-6a - Continue Operating WTP at 2000gpm

Item	Notes	Quantity	Unit	Unit Cost 2019[1]	Total Cost
Capital Costs					
Direct Construction					
Construct 2000gpm WTP	f	1	LS	$22,000,000.00	$22,000,000
Total					$22,000,000
Indirect Construction					
Mobilization/Demobilization	a		5%		$1,100,000
Water/Sediment Control	a		5%		$1,100,000
Total					$2,200,000
Construction Subtotal					**$24,200,000**
Contingency	b	10% Scope + 25% Bid			$8,470,000
Subtotal					**$32,670,000**
Remedial design	c	6%			$1,960,200
Project/Construction Management	c	11%			$3,593,700
Total					$5,553,900
Total Capital Costs					**$38,223,900**
Initial Annual O&M Costs					
Total Initial Annual O&M Costs					**$0**
Subsequent Annual O&M Costs					
O&M Costs	d, e	1	LS	$1,500,000	$1,500,000
Contingency	c	35%			$525,000
Total Subsequent Annual O&M Costs					**$2,025,000**
Periodic Costs					
Total Periodic Costs					**$0**

Notes

a Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Page 5-11 and Exhibit 5-6

b Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Exhibit 5-8

c Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Chapter 5

d Costs provided by Simplot

e Based on Pole Canyon cost estimates

1 Calculated using 2019 cost index information from RSMeans site

DRAFT

APRIL 2020

Table B-2m
SW-6b - Increase WTP to 3000 gpm

Item	Notes	Quantity	Unit	Unit Cost 2019[1]	Total Cost
Capital Costs					
Direct Construction					
Construct 2000gpm WTP	e	1	LS	$22,000,000.00	$22,000,000
Expand to 3000gpm	d	1	LS	$17,000,000.00	$17,000,000
Total					$39,000,000
Indirect Construction					
Mobilization/Demobilization	a		5%		$1,950,000
Water/Sediment Control	a		5%		$1,950,000
Total					$3,900,000
Construction Subtotal					**$42,900,000**
Contingency	b	10% Scope + 25% Bid			$15,015,000
Subtotal					**$57,915,000**
Remedial design	c	6%			$3,474,900
Project/Construction Management	c	11%			$6,370,650
Total					$9,845,550
Total Capital Costs					**$67,760,550**
Initial Annual O&M Costs					
Total Initial Annual O&M Costs					**$0**
Subsequent Annual O&M Costs					
O&M Costs	d, e	1	LS	$2,250,000	$2,250,000
Contingency	c	35%			$787,500
Total Subsequent Annual O&M Costs					**$3,037,500**
Periodic Costs					
Total Periodic Costs					**$0**

Notes

a Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Page 5-11 and Exhibit 5-6

b Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Exhibit 5-8

c Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Chapter 5

d Costs provided by Simplot

e Based on Pole Canyon cost estimates

1 Calculated using 2019 cost index information from RSMeans site

DRAFT

APRIL 2020

Table B-2n
Physical Barriers

Item	Notes	Quantity	Unit	Unit Cost[1]	Total Cost
Capital Costs					
Direct Construction					
Fence Installation at DS-7	a, k	164	LF	$8.41	$1,400
Fence Installation at LP-1	a, k	574	LF	$8.41	$4,800
Fence Installation at DP-7	a, k	328	LF	$8.41	$2,800
Fence Installation at EP-2	a, k	656	LF	$8.41	$5,500
Transport Chert (Includes loading)	I, j, k	200	LCY	$5.35	$1,100
Install Chert at DS-7	h, j, k	200	CY	$3.42	$700
Transport Chert (Includes loading)	I, j, k	100	LCY	$5.35	$500
Install Chert at LP-1	h, j, k	100	CY	$3.42	$300
Transport Chert (Includes loading)	I, j, k	35	LCY	$5.35	$200
Install Chert at DP-7	h, j, k	35	CY	$3.42	$100
Transport Chert (Includes loading)	I, j, k	65	LCY	$5.35	$300
Install Chert at EP-2	h, j, k	65	CY	$3.42	$200
Signage	b	4	Each	$28.04	$100
Total					$18,000
Indirect Construction					
Mobilization/Demobilization	c	5%	%		$900
Water/Sediment Control	c	5%	%		$900
Total					$1,800
Construction Subtotal					**$19,800**
Contingency	d	10% Scope + 25% Bid			$6,900
Total Construction					**$26,700**
Remedial Design	e	20%			$5,300
Project/Construction Management	e	25%			$6,700
Total Capital Costs					**$38,700**
Initial Annual O&M Costs					
O&M Costs					
Contingency					
Total Initial Annual O&M Costs					**$0**
Subsequent Annual O&M Costs					
O&M Costs	a, f	1	LS	$1,000	$1,000
Contingency	d	35%			$400
Total Subsequent Annual O&M Costs					**$1,400**
Periodic Costs					**$0**
Total Periodic Costs					**$0**

Notes

[a] Determined from RS Means (Derrick Hale 2018) (01 56 23.10 0100) assuming 6' chain link fence will be sufficient
[b] Determined from RS Means (Derrick Hale 2018) (01 58 13.50 0020) assuming signs will be mounted to fencing
[c] Based on similar project ("S:\Jobs\Smoky\CERCLA\FS\FSTM2\Cost Estimates\Smoky Canyon Cost EstimatesTables_Final.xls")
[d] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Page 5-11 and Exhibit 5-6
[e] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Exhibit 5-8
[f] Based on similar projects
[g] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Chapter 5
[h] Determined from RS Means (Derrick Hale 2018) (31 23 23.15 6020) assuming 3 CY of rock per location
[i] Determined from RS Means (Derrick Hale 2018) (31 23 23.20 0052) estimating a haul distance of 6 miles
[j] Volumes calculated by mulitplying area by average depth of 3 ft.
[k] Quantities determined by GIS
[1] Calculated using cost index information from RSMeans site (https://www.rsmeansonline.com/references/unit/refpdf/hci.pdf)

DRAFT
APRIL 2020

Table B-3
Alluvial Groundwater Remedial Alternative Cost Summary (Present Value)

Cost Item Description	Alternative AG-1	Alternative AG-2	Alternative AG-3	Alternative AG-4
Capital Costs	$0	$0	$50,000	$444,100
Periodic Costs	$0	$215,800	$215,800	$570,700
Annual O&M Costs	$0	$201,100	$201,100	$948,000
Total Present Worth	**$0**	**$416,900**	**$466,900**	**$1,962,800**

Table B-3a
Present Value of Alternative AG-1: No Further Action

Item	Notes	Start Year	End Year	Estimated Cost	Present Value[1]
Capital Costs					
N/A		0	0	$0	$0
Total				**$0**	**$0**
Annual O&M Costs					
N/A		0	0	$0	$0
Total				**$0**	**$0**
Periodic Costs					
N/A		0	0	$0	$0
Total				**$0**	**$0**
Net Present Value					**$0**

Notes

1 0.07 Interest rate used for Present Value

DRAFT

APRIL 2020

Table B-3b

Present Value of Alternative AG-2: Monitored Natural Attenuation

Item	Notes	Start Year	End Year	Estimated Cost	Present Value[1]
Capital Costs					
N/A		0	0	$0	$0
Total				**$0**	**$0**
Annual O&M Costs					
Monitoring	a, c	0	30	$15,000	$201,100
Total				**$15,000**	**$201,100**
Periodic Costs					
5 Year Review	a, b	5	30	$100,000	$215,800
Total				**$100,000**	**$215,800**
Net Present Value					**$416,900**

Notes

1 0.07 Interest rate used for Present Value

a Present value calculated according to EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" Chapter 4

b Based on assumed level of effort for summarizing inspection findings, summarizing operation and maintenance activities completed, preparing presentation graphics for EPA lead 5-year review meetings

c Assuming 3 sampling locations being sampled by a 2-man crew. Includes field sampling activities, laboratory costs, (including QA/QC samples), data validation, data summary report preparation, and field sampling activities.

DRAFT

APRIL 2020

Table B-3c
Present Value of Alternative AG-3: Institutional Controls and MNA

Item	Notes	Start Year	End Year	Estimated Cost	Present Value[1]
Capital Costs					
Implementation	a, c	0	0	$50,000	$50,000
Total				**$50,000**	**$50,000**
O&M Costs					
Monitoring	a	0	30	$15,000	$201,100
Total				**$15,000**	**$201,100**
Periodic Costs					
5 Year Review	a, b	5	30	$100,000	$215,800
Total				**$100,000**	**$215,800**
Net Present Value					**$466,900**

Notes

1 0.07 Interest rate used for Present Value

a Present value calculated according to EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" Chapter 4

b Based on assumed level of effort for summarizing inspection findings, summarizing operation and maintenance activities completed, preparing presentation graphics for EPA lead 5-year review meetings

c Based on cost for preparation of Institutional Control Implementation and Assurance Plan (ICIAP)

d Assuming 3 sampling locations being sampled by a 2-man crew. Includes field sampling activities, laboratory costs, (including QA/QC samples), data validation, data summary report preparation, and field sampling activities.

DRAFT

APRIL 2020

Table B-3d

Present Value of Alternative AG-4: Permeable Reactive Barrier, ICs, and MNA

Item	Notes	Start Year	End Year	Estimated Cost	Present Value[1]
Capital Costs					
Permeable Reactive Barrier Construction	a, c, d, e	0	0	$394,130	$394,100
Institutional Controls (Deed Restrictions)	f	0	0	$50,000	$50,000
Total				**$444,130**	**$444,100**
O&M Costs					
Permeable Reactive Barrier O&M	a, c	1	30	$8,100	$100,500
Monitoring (MNA)	a, e	1	30	$15,000	$186,100
Monitoring (PRB)	a, e	1	5	$60,000	$246,000
Monitoring (PRB)	a	6	30	$50,000	$415,400
Total				**$133,100**	**$948,000**
Periodic Costs					
5 Year Review	a, b	5	30	$100,000	$215,800
Media Replacement (Year 10)	a, c, g	10	10	$394,130	$200,400
Media Replacement (Year 20)	a, c, g	20	20	$394,130	$101,900
Media Replacement (Year 30)	a, c, g	30	30	$394,130	$51,800
Carbon Ammendment (Year 10)	a	10	10	$1,000	$500
Carbon Ammendment (Year 20)	a	20	20	$1,000	$300
Carbon Ammendment (Year 30)	a	30	30	$1,000	$100
Total				**$1,284,390**	**$570,700**
Net Present Value					**$1,962,800**

Notes

1 0.07 Interest rate used for Present Value

a Present value calculated according to EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" Chapter 4

b Based on assumed level of effort for summarizing inspection findings, summarizing operation and maintenance activities completed, preparing presentation graphics for EPA lead 5-year review meetings

c Used estimate based on 2x flow

d Construction time for Conda PRB was ~3 weeks

e Assuming 3 sampling locations for MNA and 10 sampling locations for the PRB being sampled by a 2-man crew. Includes field sampling activities, laboratory costs, (including QA/QC samples), data validation, data summary report preparation, and field sampling activities.

f Based on cost for preparation of Institutional Control Implementation and Assurance Plan (ICIAP)

g Complete media replacment will occur between 10 and 20 years post-construction. This will involve complete removal of old treatment media.

DRAFT

APRIL 2020

Table B-3e
AG-4 - Permeable Reactive Barrier (Based on estimated dimensions)

Item	Notes	Quantity[1]	Unit	Unit Cost (Conda)	Total Cost
Capital Costs					
Materials					
Chopped alfalfa	a, g	370	CY	$50	$18,500
Wood shavings, delivered	a, g	1200	CY	$13	$15,600
Sand, no delivery	a, g	1500	CY	$11	$17,000
8 oz/yd2 geotextile	a, i	1000	SY	$1	$700
Piping, misc. materials	a	1	LS	$15,000	$15,000
Total					**$66,800**
Direct Construction					
Excavate PRB	a, j	3080	BCY	$10	$30,800
Blend treatment media	a	3080	CY	$9	$27,500
Haul media to site	a	900	Ton	$15	$13,500
Place treatment media	a	3080	CY	$5	$15,000
Treatment cell Dinwoody cover	a, j	250	CY	$5	$1,400
Additional monitoring wells	a	5	Each	$3,610	$18,100
Total					**$106,300**
Indirect Construction					
Mobilization/Demobilization	k	5%			$5,315
Water/Sediment Control	k	5%			$5,315
As-built drawings & completion report	a	1	Est.	$16,000	$16,000
Sampling Plan	a	1	Est.	$32,000	$32,000
Total					**$58,630**
Construction Subtotal					**$231,730**
Contingency	b	10% scope + 25% bid			$81,100
Subtotal					**$312,830**
Remedial Design	c	12%			$37,500
Project/Construction Management	c	14%			$43,800
Total					$81,300
Total Capital Costs					**$394,130**
Initial Annual O&M Costs					
O&M Costs					
Contingency					
Total Initial Annual O&M Costs					**$0**
Subsequent Annual O&M Costs					
O&M Costs	a, f	1	LS	$6,000	$6,000
Contingency	d	35%			$2,100
Total Subsequent Annual O&M Costs					**$8,100**
Periodic Costs					
Carbon Ammendment	h	1	LS	$1,000	$1,000
Replacement of media	f	1	Ea.		$394,130
Total Periodic Costs					**$395,130**

Notes

1 Calculated using cost index information from RSMeans site (https://www.rsmeansonline.com/references/unit/refpdf/hci.pdf)
a Based on estimates for Conda PRB, assumed same quantitiy needed
b Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Page 5-11 and Exhibit 5-6
c Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Exhibit 5-8
d Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Chapter 5
e Based on DS-7 treatment system cost estimate, with less sampling
f Based on PRB at Conda, assuming replacement will need to occur around the 20 year mark. PRB will need to be excavated and media replaced
g Treatment media consists of 50% well-graded sand, 37.5% wood ships/shavings, and 12.5% chopped alfalfa
h Carbon Ammendment means periodic replenishment of carbon source (sugar) for bacteria
i Assumes fabric only covering top of PRB, not lining interior of trench. Top PRB dimensions 20'x200' + 50% safety factor
j PRB dimensions 20'x20'x200' with a 1.5' cover.
k Based on previous Smoky Canyon Cost Estimates - "assumes pipe would need to be periodically cleaned, upstream basin would need to be periodically cleaned, and pipe would need periodic maintenance"

DRAFT

APRIL 2020

TABLE B-33. SOLIDS AND SOILS REMEDIAL ALTERNATIVE COST SUMMARY

TABLE B-34A. PRESENT VALUE OF ALTERNATIVE S-1: NO FURTHER ACTION

TABLE B-35B. PRESENT VALUE OF ALTERNATIVE S-2: ROCK COVERS ON SOILS IN SEEP AND RIPARIAN AREAS

TABLE B-36C. PRESENT VALUE OF ALTERNATIVE S-3: 2-FOOT DINWOODY OR SALT LAKE FORMATION COVERS ON UNCOVERED AREAS OF ODAS AND ROCK COVERS ON SOILS IN SEEP AND RIPARIAN AREAS

TABLE B-37D. PRESENT VALUE OF ALTERNATIVE S-4: 5-FOOT DINWOODY OR SALT LAKE FORMATION/CHERT COVERS ON UNCOVERED AREAS OF ODAS AND ROCK COVERS ON SOILS IN SEEP AND RIPARIAN AREAS

TABLE B-38E. COST BREAKDOWN OF ALTERNATIVE S-2: ROCK COVERS ON SOILS IN SEEP AND RIPARIAN AREAS

TABLE B-39F. COST BREAKDOWN OF ALTERNATIVE S-3: 2-FOOT DINWOODY OR SALT LAKE FORMATION COVERS ON UNCOVERED AREAS OF ODAS AND ROCK COVERS ON SOILS IN SEEP AND RIPARIAN AREAS

TABLE B-40G. COST BREAKDOWN OF ALTERNATIVE S-4: 5-FOOT DINWOODY OR SALT LAKE FORMATION/CHERT COVERS ON UNCOVERED AREAS OF ODAS AND ROCK COVERS ON SOILS IN SEEP AND RIPARIAN AREAS

Table B-4
Solids and Soil Remedial Alternative Cost Summary (Present Value)

Cost Item Description	Alternative S-1	Alternative S-2	Alternative S-3	Alternative S-4
Capital Costs	$0	$22,400	$17,874,900	$33,215,700
Periodic Costs	$0	$215,800	$215,800	$215,800
Annual O&M Costs	$0	$17,400	$1,543,000	$1,543,000
Total Present Worth	**$0**	**$255,600**	**$19,633,700**	**$34,974,500**

DRAFT

APRIL 2020

Table B-4a
Present Value of Alternative S-1: No Further Action

Item	Notes	Start Year	End Year	Estimated Cost	Present Value[1]
Capital Costs					
N/A		0	0	$0	$0
Total				**$0**	**$0**
Annual O&M Costs					
N/A		0	0	$0	$0
Total				**$0**	**$0**
Periodic Costs					
N/A		0	0	$0	$0
Total				**$0**	**$0**
Net Present Value					**$0**

Notes
1 0.07 Interest rate used for Present Value

DRAFT
APRIL 2020

Table B-4b
Present Value of Alternative S-2: Rock Covers on Soils in Seep/Riparian Areas

Item	Notes	Start Year	End Year	Estimated Cost	Present Value[1]
Capital Costs					
Rock Covers	a	0	0	$22,440	$22,400
Total				**$22,440**	**$22,400**
O&M Costs					
Rock Covers	a	1	30	$1,400	$17,400
Total				**$1,400**	**$17,400**
Periodic Costs					
5 Year Review	a, b	5	30	$100,000	$215,800
Total				**$100,000**	**$215,800**
Net Present Value					**$255,600**

Notes

1
0.07 Interest rate used for Present Value

a
Present value calculated according to EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" Chapter 4

b
Assumed level of effort for summarizing inspection findings, summarizing operation and maintenance activities completed, preparing presentation graphics for EPA lead 5-year review meetings

c Based on cost for preparation of Institutional Control Implementation and Assurance Plan (ICIAP)

DRAFT

APRIL 2020

Table B-4c
Alternative S-3
2-Foot Dinwoody or Salt Lake Formation Covers on Uncovered Areas of ODAs and Rock Covers on Soils in Seep and Riparian Areas

Item	Notes	Start Year	End Year	Estimated Cost	Present Value[1]
Capital Costs					
Cover	a, c	0	2	$21,778,100	$17,804,600
Rock Covers	a	0	1	$22,440	$20,300
Institutional Controls	e	0	0	$50,000	$50,000
Total				**$21,850,540**	**$17,874,900**
Annual O&M Costs					
Cover (Initial)	a	3	8	$291,600	$1,214,000
Cover (Subsequent)	a	9	30	$48,600	$312,900
Rock Covers	a	2	30	$1,400	$16,100
Total				**$50,000**	**$1,543,000**
Periodic Costs					
5 Year Review	a, b	5	30	$100,000	$215,800
Total				**$100,000**	**$215,800**
Net Present Value					**$19,633,700**

Notes

1 0.07 Interest rate used for Present Value

a Present value calculated according to EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" Chapter 4

b Assumed level of effort for summarizing inspection findings, summarizing operation and maintenance activities completed, preparing presentation graphics for EPA lead 5-year review meetings

c Based on time for Pole Canyon cover, which was approx. 1 field season. Scaled up/down based on acreage and cover type.

d Assuming 10 sampling locations being sampled by a 2-man crew. Includes field sampling activities, laboratory costs, (including QA/QC samples), data validation, data summary report preparation, and field sampling activities.

e Based on cost for preparation of Institutional Control Implementation and Assurance Plan (ICIAP)

DRAFT

APRIL 2020

Table B-4d

Alternative S-4

5-Foot Dinwoody or Salt Lake Formation/Chert Covers on Uncovered Areas of ODAs and Rock Covers on Soils in Seep and Riparian Areas

Item	Notes	Start Year	End Year	Estimated Cost	Present Value[1]
Capital Costs					
Cover	a, c	0	2	$40,542,600	$33,145,400
Rock Covers	a	0	1	$22,440	$20,300
Institutional Controls	e	0	0	$50,000	$50,000
Total				**$40,615,040**	**$33,215,700**
Annual O&M Costs					
Cover (Initial)	a	3	8	$291,600	$1,214,000
Cover (Subsequent)	a	9	30	$48,600	$312,900
Rock Covers	a	2	30	$1,400	$16,100
Total				**$50,000**	**$1,543,000**
Periodic Costs					
5 Year Review	a, b	5	30	$100,000	$215,800
Total				**$100,000**	**$215,800**
Net Present Value					**$34,974,500**

Notes

1 0.07 Interest rate used for Present Value

a Present value calculated according to EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" Chapter 4

b Assumed level of effort for summarizing inspection findings, summarizing operation and maintenance activities completed, preparing presentation graphics for EPA lead 5-year review meetings

c Based on time for Pole Canyon cover, which was approx. 1 field season. Scaled up/down based on acreage and cover type.

d Assuming 10 sampling locations being sampled by a 2-man crew. Includes field sampling activities, laboratory costs, (including QA/QC samples), data validation, data summary report preparation, and field sampling activities.

e Based on cost for preparation of Institutional Control Implementation and Assurance Plan (ICIAP)

DRAFT

APRIL 2020

Table B-4e
S-2 - Rock Covers

Item	Notes	Quantity	Unit	Unit Cost	Total Cost
Capital Costs					
Direct Construction					
Transport Chert (Includes loading)	e, h, i	600	LCY	$5.35	$3,200
Install Chert at DS-7	e, g, i	600	CY	$3.42	$2,000
Transport Chert (Includes loading)	e, h, i	300	LCY	$5.35	$1,600
Install Chert at LP-1	e, g, i	300	CY	$3.42	$1,000
Transport Chert (Includes loading)	e, h, i	300	LCY	$5.35	$1,600
Install Chert at ES-4	e, g, i	300	CY	$3.42	$1,000
Total					**$10,400**
Indirect Construction					
Mobilization/Demobilization		5%	%		$520
Water/Sediment Control		5%	%		$520
Total					**$1,040**
Construction Subtotal					**$11,440**
Contingency	b	10% Scope + 25% Bid			$4,000
Total Construction					**$15,440**
Remedial Design	c	20%			$3,100
Project/Construction Management	c	25%			$3,900
Total Capital Costs					**$22,440**
Initial Annual O&M Costs					
O&M Costs					
Contingency					
Total Initial Annual O&M Costs					**$0**
Subsequent Annual O&M Costs					
O&M Costs	f	1	LS	$1,000	$1,000
Contingency	d	35%			$400
Total Subsequent Annual O&M Costs					**$1,400**
Periodic Costs					**$0**
Total Periodic Costs					**$0**

Notes
[a] Acreage calculated using GIS
[b] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Page 5-11 and Exhibit 5-6
[c] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Exhibit 5-8
[d] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Chapter 5
[e] Quantities determined by GIS
[f] Determined from previous Smoky Canyon cost estimates
[g] Determined from RS Means (Derrick Hale 2018) (31 23 23.15 6020) assuming 3 CY of rock per location
[h] Determined from RS Means (Derrick Hale 2018) (31 23 23.20 0052) estimating a haul distance of 6 miles
[i] Volumes calculated by mulitplying area by average depth of 3 ft.
[j] Costs provided by Simplot

DRAFT
APRIL 2020

Table B-4f

Alternative S-3

2-Foot Dinwoody or Salt Lake Formation/Chert Covers

Item	Notes	Quantity	Unit	Cost/Acre	Total Cost
Capital Costs					
PREPARE SLOPE FOR COVER					
Regrade/Compact/Strip	e			$1,000	
3rd Party Survey/CQC/Design	e			$1,000	
PREPARE MATERIALS					
Construct Haul Road to DW/SLF/Topsoil Borrows	e			$15,009	
Haul Loose Dinwoody to Project Area	e			$13,310	
VEGETATION					
Seeding and Fertilizer	e			$4,000	
Bonded Fiber Matrix Hydromulch	e			$1,500	
EROSION CONTROL					
Purchase and Install Silt Fence	e			$200	
Purchase and Install Wattles	e			$2,000	
MOBILIZATION/DEMOBILIZATION					
Equipment Mobilization and Training	e			$250	
Total Cost Per Acre				$38,300	
Acreage	a	360	acre		
Total					**$13,788,000**
Construction Subtotal					**$13,788,000**
Contingency	b	10% Scope + 25% Bid			$4,825,800
Subtotal					**$18,613,800**
Remedial Design	c	6%			$1,116,800
Project/Construction Management	c	11%			$2,047,500
Total					$3,164,300
Total Capital Costs					**$21,778,100**
Initial Annual O&M Costs					
O&M Costs	a, f	360	acre	$600	$216,000
Contingency	d	35%			$75,600
Total Initial Annual O&M Costs					**$291,600**
Subsequent Annual O&M Costs					
O&M Costs	a, f	360	acre	$100	$36,000
Contingency	d	35%			$12,600
Total Subsequent Annual O&M Costs					**$48,600**
Periodic Costs					**$0**
Total Periodic Costs					**$0**

Notes

[a] Acreage calculated using GIS

[b] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Page 5-11 and Exhibit 5-6

[c] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Exhibit 5-8

[d] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Chapter 5

[e] Costs provided by Simplot

[f] Determined from previous Smoky Canyon cost estimates

[g] Deterined from Smoky Canyon RA Report

DRAFT

APRIL 2020

Table B-4g
Alternative S-4
5-Foot Dinwoody or Salt Lake Formation/Chert Covers

Item	Notes	Quantity	Unit	Cost/Acre	Total Cost
Capital Costs					
PREPARE SLOPE FOR COVER					
Regrade/Compact/Strip	e			$1,000	
3rd Party Survey/CQC/Design	e			$1,000	
PREPARE MATERIALS					
Construct Haul Road to DW/SLF/Topsoil Borrows	e			$15,009	
Haul Core Material for Drainage Benches to Stockpile	e			$7,200	
Haul Loose Dinwoody to Project Area	e			$13,310	
Haul Topsoil to Project Area	e			$13,310	
MISC. LAYERS					
2-Ft CH for Deep Dinwoody	e			$6,500	
2-FT Dinwoody/SLF (Loose)	e			$6,000	
VEGETATION					
Seeding and Fertilizer	e			$4,000	
Bonded Fiber Matrix Hydromulch	e			$1,500	
EROSION CONTROL					
Purchase and Install Silt Fence	e			$200	
Purchase and Install Wattles	e			$2,000	
MOBILIZATION/DEMOBILIZATION					
Equipment Mobilization and Training	e			$250	
Total Cost Per Acre				$71,300	
Acreage	a	360	acre		
Total					**$25,668,000**
Construction Subtotal					**$25,668,000**
Contingency	b	10% Scope + 25% Bid			$8,983,800
Subtotal					**$34,651,800**
Remedial Design	c	6%			$2,079,100
Project/Construction Management	c	11%			$3,811,700
Total					$5,890,800
Total Capital Costs					**$40,542,600**
Initial Annual O&M Costs					
O&M Costs	a, f	360	acre	$600	$216,000
Contingency	d	35%			$75,600
Total Initial Annual O&M Costs					**$291,600**
Subsequent Annual O&M Costs					
O&M Costs	a, f	360	acre	$100	$36,000
Contingency	d	35%			$12,600
Total Subsequent Annual O&M Costs					**$48,600**
Periodic Costs					**$0**
Total Periodic Costs					**$0**

Notes

[a] Acreage calculated using GIS

[b] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Page 5-11 and Exhibit 5-6

[c] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Exhibit 5-8

[d] Determined from EPA "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", Chapter 5

[e] Costs provided by Simplot

[f] Determined from previous Smoky Canyon cost estimates

[g] Deterined from Smoky Canyon RA Report

DRAFT

APRIL 2020

APPENDIX C

STATISTICAL ANALYSIS OF SOIL DATA

DRAFT

APPENDIX C
Statistical Analysis of Soil Data

Prepared for:

J.R. Simplot Company
Smoky Canyon Mine
1890 Smoky Canyon Road
Afton, Wyoming 83110

TABLE OF CONTENTS

Tables

Figures

LIST OF ABBREVIATIONS

95UCL	95 Percent Upper Confidence Limit on the Mean
CEMPP	Comprehensive Environmental Monitoring Program Plan
COPC	Chemical of Potential Concern
FS	Feasibility Study
FSTM#2	Feasibility Study Technical Memorandum #2
mg/kg	Milligrams per kilogram
NTCRA	Non-Time-Critical Removal Action
ODA	Overburden Disposal Area
QC	Quality Control
RI	Remedial Investigation
USEPA	U.S. Environmental Protection Agency

1 INTRODUCTION

To support the Smoky Canyon Mine (Site) Feasibility Study (FS), a dataset was developed to be representative of current selenium and arsenic concentrations in surface soils in disturbance areas within the Lease Area. These disturbance areas are the reclaimed pits and panels associated with Overburden Disposal Areas (ODAs) at the Site. This appendix describes the compilation of data for the dataset and the statistical analysis that was performed to support the detailed analysis of alternatives in Feasibility Study Technical Memorandum #2 (FSTM#2).

2 COMPILATION OF DATASET

Figure C-1 shows the sampling locations in each mine panel and Table C-1 presents selenium and arsenic concentrations in the surface soil samples shown in the figure. Details are presented below.

2.1 SOIL DATASET DETAILS

The Remedial Investigation (RI; Formation Environmental [Formation] 2014) presented a comprehensive evaluation of the nature and extent of contamination based on soil sampling of reclaimed ODA panels in 2010. Since the RI sampling, soil sampling of reclaimed areas has taken place under the Comprehensive Environmental Monitoring Program Plan (CEMPP; Formation 2015) and these results are also included in this dataset. In addition, a Dinwoody cover has been installed at the surface of the Pole Canyon ODA by the 2013 NTCRA (Formation 2017). The RI, Pole Canyon and CEMPP sampling results together provide current spatial coverage of the reclaimed ODAs and are of suitable data quality. The dataset includes 126 selenium results from 87 locations and 59 arsenic results from 59 locations[1].

To support the RI, ten surface soil samples (0 to 6 inches in depth) were collected from each reclaimed ODA panel (except Panels B and C) in 2010, as summarized in Appendix E-4 of the RI Report (Formation 2014). These 2010 sample locations include APL-10 through APL-28, DPL-22 through DPL-35, and EPL-10 through EPL-29. Each sample was collected as a 5-point composite from a 100-foot by 100-foot sampling area and analyzed for a list of 22 RI Chemicals of Potential Concern (COPCs) including selenium and arsenic. In areas where additional reclamation has taken place since 2010 (including Panels B and C), surface soil samples (0 to 12 inches in depth) were collected for the CEMPP. These soil samples were collected as a 5-point composite from a 100-foot by 100-foot sampling area and analyzed for seven metals/metalloids including selenium (Formation 2015). CEMPP samples were collected multiple years (e.g., first year after seeding, three years after seeding, etc.) and all samples were considered as representative of surface soil conditions.

[1] Because CEMPP samples were not analyzed for arsenic, results for this analyte are not available for Panels B or C.

The following list identifies the panels and years sampled for the CEMPP and included in this dataset:

- 3 locations from A-panel North reclamation area (2011, 2012)
- 2 locations from A-panel South reclamation area (2011, 2014, 2019)
- 2 locations from B-panel reclamation area (2011, 2012, 2018)
- 2 locations from B-external reclamation area (2011, 2012, and 2017)
- 10 locations from C-panel reclamation area (2010, 2011, 2015, 2016)
- 7 locations from E-panel E0 reclamation area (2013, 2014, 2015, 2016)

The RI sampling locations were reviewed to ascertain if any samples collected were no longer representative of the current surface conditions as a result of reclamation efforts since 2010, or if any of the subsequent CEMPP samples had been collected at RI locations. In most cases, CEMPP sampling in newly reclaimed areas did not overlap with areas sampled during the RI and so both the RI and CEMPP results are relevant except where outlined below.

The following RI data were not included because they were no longer considered representative of current surface conditions:

- One 2010 RI location (APL-29) was sampled in an area of North A-pit that had subsequent reclamation work and CEMPP sampling, and so data from this location were excluded from the dataset. CEMPP location NA-B1P2 was sampled in that area in 2011 and 2012 and those data were included as representative results.
- 2010 RI locations that were sampled on the Pole Canyon ODA were not included in the dataset because a Dinwoody/Chert cover was placed on the ODA in 2015 as part of the Pole Canyon ODA 2013 Non-Time-Critical Removal Action (NTCRA) (Formation 2016a). Material from the Dinwoody Borrow Area west of the D-panel was used for the Pole NTCRA cover. Three soil samples collected from test pits (composite from 0 to 48 inches) in this borrow area in 2015 (Formation 2016b) were included in the dataset as representative of the soils used to cover the ODA.

Data usability levels and appropriate data uses are outlined in Table 3.4-1 in the RI Report (Formation 2014). This soil dataset includes data categorized as Level 3b and 4, which are considered usable for all site characterization and engineering purposes, including the characterization of nature and extent of contamination, source characterization, and identification of transport pathways. Primary sample results were included in the dataset. Results from quality control (QC) samples (e.g., field duplicates, field split samples, lab QC samples) were previously evaluated as part of project-specific precision goals (e.g., refer to Section 4.4.1 in RI Report; Formation 2014) and were excluded.

2.2 A-Panel Outlier Analysis

Soil selenium concentrations from Panel A ranged from 0.25 to 245 milligram per kilogram (mg/kg) with an average concentration of 15.11 ± 44.8 mg/kg. The selenium result from one location (APL-10) appears to be an outlier based on an evaluation of the distribution of the full dataset from Panel A.

Because the data from A-Panel do not fit a normal distribution, parametric statistical tests, such as the Rosner's Test provided in U.S. Environmental Protection Agency's (USEPA) ProUCL software package (USEPA 2016) are not appropriate for use. For non-parametric data, a review of the box plot of the data is an appropriate step in outlier identification. As indicated in Figure C-2, the data show that the 245 mg/kg concentration is clearly outside of the range of the rest of the population of selenium data from Panel A. The two additional samples shown as dots on the box plot with selenium concentrations slightly less than 50 mg/kg may also be outliers. However, based on the relationship between the three possible outliers and the rest of the Panel A soil data, it appears that the result from APL-10 is a clear outlier from the remaining data. As a result, panel-wide soils data from Panel A were considered without the data from APL-10.

The 245 mg/kg concentration observed at APL-10 is nearly five times higher than the next highest measured selenium concentration from within Panel A (46.9 mg/kg in sample APL-15) or in any of the other mine panels where the maximum detected selenium concentration was equal to 45.6 mg/kg in sample DPL-16 on D-Panel. These data strongly suggest that the data from APL-10 was a significant outlier in the dataset.

Following removal of the outlier sample, soil selenium concentrations in Panel A ranged from 0.25 to 46.9 mg/kg with an average concentration of 7.19 ± 11.3 mg/kg. The 95 percent upper confidence limit on the mean (95UCL) of the A-Panel data was 50.8 mg/kg when all data were included in the calculation and considerably lower (11.4 mg/kg) when the outlier sample was excluded from the calculations.

3 Statistical Analysis

Tables C-2 and C-3 present summary statistics and 95UCL calculations for selenium and arsenic concentrations for each Panel and ODA. The 95UCLs were calculated using USEPA ProUCL software (USEPA 2016) version 5.1.002. The first recommended value by ProUCL is provided, along with the 95UCL estimation method recommended for use by the software. Based on 126 sample results, selenium concentrations in surface soils ranged from non-detect to 46.9 mg/kg across the Site (excluding the outlier sample in A-Panel). Average selenium concentrations by panel ranged from 0.23 mg/kg (Dinwoody Borrow area west of D-panel/Pole ODA) to 10.5 mg/kg (Panel D), and the corresponding 95UCL values per panel ranged from 0.23 to 16.3 mg/kg (Table C-2). Based on 59 sample results, arsenic concentrations in surface soils ranged from 3.1 to 25.3 mg/kg across the Site. Average arsenic concentrations by panel ranged from 5.3 mg/kg (Panel E) to 11.6 mg/kg (Panel D), and the corresponding 95UCL values per panel ranged from 7.6 to 14.97 mg/kg per panel (Table C-3).

Site-wide area-weighted concentrations are also provided on Tables C-2 and C-3 for selenium and arsenic, respectively. To calculate are-weighted concentrations, the percentage of each panel's area out of the total disturbance area (1202 acres) was calculated and used as an area multiplier. Area-weighted concentrations for each panel were then calculated by multiplying the mean and 95UCL concentration by the area multiplier and summing across all areas for an overall Site-wide concentration. Because soil samples collected as part of reclamation sampling on Panels B and C have not been analyzed for arsenic, the arsenic concentration from Pole Canyon ODA (Dinwoody Borrow) was also used for Panels B and C which have topsoil at the surface. The Site-wide area-weighted concentrations based on 95UCL is 6.96 mg/kg for selenium (Table C-2) and 10.16 mg/kg for arsenic (Table C-3).

4 References

Formation Environmental, LLC (Formation). 2014. Smoky Canyon Mine Remedial Investigation/ Feasibility Study Remedial Investigation Report. Prepared for J.R. Simplot Company, September.

Formation Environmental, LLC (Formation). 2015. Smoky Canyon Mine Comprehensive Environmental Monitoring Program Plan, Revision No. 4. Prepared for J.R. Simplot Company, August (replacement pages in February 2016).

Formation Environmental, LLC (Formation). 2016a. Pole Canyon Overburden Disposal Area 2013 Non-Time-Critical Removal Action Post-Removal Site Control Plan. Prepared for J.R. Simplot Company, September.

Formation Environmental, LLC (Formation). 2016b. Smoky Canyon Mine Remedial Investigation/ Feasibility Study CERCLA Cover Material Source Evaluation Technical Memorandum. Prepared for J.R. Simplot Company, June (approved as Final in July 2016).

Formation Environmental, LLC (Formation). 2017. Final Smoky Canyon Mine Pole Canyon Overburden Disposal Area 2013 Non-Time-Critical Removal Action Construction Inspection Report. Prepared for J.R. Simplot Company. June.

U.S. Environmental Protection Agency (USEPA). 2016. ProUCL software, version 5.1.002. Available at https://www.epa.gov/land-research/proucl-software (last updated June 20, 2016).

Table C-1. Surface Soil Selenium and Arsenic Concentrations on Smoky Canyon Mine Disturbance Areas by Panel

Station	Date	Arsenic (mg/kg)			Selenium (mg/kg)		
		Result	LabQ	ValQ	Result	LabQ	ValQ
A PANEL							
APL-11	06/16/2010	13		J	17.9		
APL-12	06/16/2010	16.6		J	16.3		
APL-13	06/16/2010	11.1		J	6		
APL-14	06/16/2010	17.5		J	18.8		
APL-15	06/16/2010	22.7		J	46.9		
APL-16	06/16/2010	5.4		J	1.2		
APL-17	06/16/2010	22.5		J	10.8		
APL-18	06/16/2010	25.3		J	39.6		
APL-19	06/16/2010	8.4		J	4.1		
APL-20	06/15/2010	5.1		J	0.71		
APL-21	06/15/2010	11		J	5.1		
APL-22	06/15/2010	6.9		J	2		
APL-23	06/15/2010	3.3		J	0.54		
APL-24	06/16/2010	7.5		J	2.4		
APL-25	06/15/2010	3.4		J	0.35		
APL-26	06/15/2010	8.2		J	3.6		
APL-27	06/16/2010	7.6		J	2.6		
APL-28	06/15/2010	5.9		J	4.8		
NA-B1P1	08/01/2011	NA			0.67		
	07/17/2012	NA			0.91		
NA-B1P2	08/01/2011	NA			0.46		
	07/17/2012	NA			0.65		
NA-B1P3	08/01/2011	NA			2.57		
	07/17/2012	NA			7.24		
SA-B2P4	08/01/2011	NA			1.81		
	08/26/2019	NA			3.91		
SA-B2P5	08/01/2011	NA			2.08		
	09/04/2014	NA			0.25		
	08/26/2019	NA			4.15		
B PANEL							
B1-B1P1	08/01/2011	NA			0.66		
	07/16/2012	NA			1.03		
	07/18/2018	NA			0.96		
B1-B1P2	08/01/2011	NA			1.06		
	07/16/2012	NA			1.07		
	07/18/2018	NA			0.92		
BEXT-B2P3	08/01/2011	NA			1.59		
	07/16/2012	NA			1.95		
	08/02/2017	NA			0.824		

Table C-1. Surface Soil Selenium and Arsenic Concentrations on Smoky Canyon Mine Disturbance Areas by Panel

Station	Date	Arsenic (mg/kg)			Selenium (mg/kg)		
		Result	LabQ	ValQ	Result	LabQ	ValQ
BEXT-B2P4	08/01/2011	NA			1.1		
	07/16/2012	NA			1.94		
	08/02/2017	NA			2.11		
C PANEL							
C1-P1	07/13/2010	NA			3.77		
	07/12/2011	NA			5.06		
	08/03/2016	NA			3.83		
C1-P2	07/13/2010	NA			3.21		
	07/12/2011	NA			4.69		
	08/03/2016	NA			4.5		
C1-P3	07/13/2010	NA			2.52		
	07/12/2011	NA			3.65		
	08/03/2016	NA			4.57		
C1-P4	07/14/2010	NA			3.36		
	07/12/2011	NA			4.49		
	08/03/2016	NA			3.9		
C1-P5	07/14/2010	NA			2.71		
	07/12/2011	NA			4.15		
	08/03/2016	NA			4.37		
C2-P1	07/14/2010	NA			4.21		
	07/11/2011	NA			4.54		
	08/03/2016	NA			4.97		
C2-P2	07/14/2010	NA			3.37		
	07/11/2011	NA			4.32		
	08/03/2016	NA			4.19		
C3-P1	07/15/2010	NA			1.25		
	07/11/2011	NA			1.51		
	08/12/2015	NA			1.27	N	
C3-P2	07/15/2010	NA			3.26		
	07/11/2011	NA			7.51		
	08/12/2015	NA			3.55	N	
C3-P3	07/15/2010	NA			2.19		
	07/11/2011	NA			4.69		
	08/12/2015	NA			3.89	N	
D PANEL							
DPL-16	06/16/2010	24.6		J	45.6		
DPL-17	06/18/2010	12.6		J	3.8		
DPL-18	06/17/2010	10.8		J	4.5		
DPL-19	06/18/2010	9.8		J	2.9		
DPL-20	06/18/2010	9.1		J	5.8		
DPL-21	06/18/2010	15		J	6.8		

Table C-1. Surface Soil Selenium and Arsenic Concentrations on Smoky Canyon Mine Disturbance Areas by Panel

Station	Date	Arsenic (mg/kg)			Selenium (mg/kg)		
		Result	LabQ	ValQ	Result	LabQ	ValQ
DPL-22	06/18/2010	7.4		J	2.5		
DPL-23	06/18/2010	10.3		J	9.2		
DPL-24	06/17/2010	6.8		J	4.1		
DPL-25	06/17/2010	6.7		J	7.4		
DPL-26	06/16/2010	9.8		J	10.8		
DPL-27	06/17/2010	7.6		J	3.6		
DPL-28	06/17/2010	5.5		J	0.87		J
DPL-29	06/18/2010	16.8		J	18.1		
DPL-30	06/17/2010	16.2		J	14.6		
DPL-31	06/17/2010	16.1		J	11.6		
DPL-32	06/18/2010	19		J	42.9		
DPL-33	06/16/2010	6.1		J	1.9		
DPL-34	06/17/2010	5.4		J	4		
DPL-35	06/18/2010	15.9		J	9.7		
E PANEL							
E0-2	07/16/2014	NA			1.08		
E0-B1P1	07/01/2013	NA			1.94	*	
	07/16/2014	NA			1.37		
E0-B1P2	07/01/2013	NA			1.82	*	
	07/16/2014	NA			1.75		
E0-B2P3	08/12/2015	NA			1.02	N	
	08/02/2016	NA			1.49		
E0-B2P4	08/12/2015	NA			1.07	N	
	08/12/2015	NA			0.44	N	
	08/02/2016	NA			0.05	J	
E0-B2P5	08/02/2016	NA			0.45		
E0-LYS	07/16/2014	NA			1.63		
EPL-10	06/20/2010	5.3		J	1.1		
EPL-11	06/20/2010	5.2		J	0.46		
EPL-12	06/20/2010	7.7		J	1.5		
EPL-13	06/20/2010	7.9		J	1.3		
EPL-14	06/20/2010	7.6		J	1.8		
EPL-15	06/18/2010	12.8		J	6.8		
EPL-16	06/20/2010	5.1		J	0.93		
EPL-17	06/22/2010	5.3		J	1.3		
EPL-18	06/22/2010	3.2		J	1.4		
EPL-19	06/22/2010	3.7		J	0.67		
EPL-20	06/20/2010	4.7		J	0.68		
EPL-21	06/20/2010	4.7		J	0.94		
EPL-22	06/21/2010	4.7		J	0.18	B	
EPL-23	06/21/2010	4.8		J	0.34		

Table C-1. Surface Soil Selenium and Arsenic Concentrations on Smoky Canyon Mine Disturbance Areas by Panel

Station	Date	Arsenic (mg/kg)			Selenium (mg/kg)		
		Result	LabQ	ValQ	Result	LabQ	ValQ
EPL-24	06/21/2010	3.5		J	0.1	B	
EPL-25	06/21/2010	3.8		J	0.21	B	
EPL-26	06/21/2010	4.4		J	0.54		
EPL-27	06/21/2010	3.1		J	0.073	B	
EPL-28	06/21/2010	4.4		J	0.077	B	
EPL-29	06/21/2010	3.8		J	0.11	B	
Dinwoody Borrow West of D-panel (Pole) [1]							
DinBorrowC	03/03/2015	7.6		J	0.12	J	U
DinBorrowN	03/03/2015	NA			0.4		
DinBorrowS	03/03/2015	NA			0.16	J	U

Notes:

1 - Soil concentrations are from samples collected in the Dinwoody Borrow west of D-panel (material used for the Pole Canyon NTCRA cover).

Refer to Figure C-1 for station locations.

NA - not available

ValQ - Validation qualifier, LabQ - Laboratory qualifier

Qualifiers defined as follows: * - Duplicate was not within control limits; B - Detected at a value between the method detection limit and pratical quantitation limit; J - Result is an estimated quantity; N - Matrix spike recovery outside of control limit; U - Not detected at Detection Limit.

Table C-2. Surface Soil Selenium Concentration Statistics for Smoky Canyon Mine Disturbance Areas

Disturbance Area		Selenium Concentrations (mg/kg)													
		Date Range		Number of Samples	Detection Frequency	ND Concentration		Detected Concentration		Avg	95UCL	95UCL Estimation Method	Area Multiplier	Area-Weighted Statistic Based on Avg	Area-Weighted Statistic Based on 95UCL
Panel	Area (ac)	Min	Max			Min	Max	Min	Max						
Panel A	283	6/15/2010	8/26/2019	29	100%			0.25	46.9	7.19	11.41	95% Adjusted Gamma UCL	0.235	1.69	2.69
Panel B	129	8/1/2011	7/18/2018	12	100%			0.66	2.11	1.27	1.611	95% Adjusted Gamma UCL	0.107	0.14	0.17
Panel C	70	7/13/2010	8/3/2016	30	100%			1.25	7.51	3.78	4.175	95% Student's-t UCL	0.058	0.22	0.24
Panel D	251	6/16/2010	6/18/2010	20	100%			0.87	45.6	10.53	16.26	95% Adjusted Gamma UCL	0.209	2.20	3.40
Panel E	356	6/18/2010	8/2/2016	32	100%			0.05	6.8	1.08	1.504	95% Adjusted Gamma UCL	0.296	0.32	0.45
Pole ODA [1]	113	3/3/2015	3/3/2015	3	33%	0.12	0.16	0.4	0.4	0.23	0.23	Fewer than 4 detected values; used average value	0.094	0.02	0.02
Total Area (ac):	1202		**Total count:**	126					**Overall:**	4.6	6.8	KM H-UCL	**Sitewide:**	4.59	6.96

Notes:

1 - Soil concentrations are from samples collected in the Dinwoody Borrow west of D-panel (material used for the Pole Canyon NTCRA cover).

95UCL = 95th upper confidence limit on the mean

ac = acre

mg/kg = milligram per kilogram

min = minimum; max = maximum; avg = average

ND = non-detected

Refer to Table C-1 and Figure C-1 for sampling locations included in the 95UCLs.

95UCLs were calculated using USEPA ProUCL software, version 5.1.002. First recommended value by ProUCL is provided, along with the 95UCL estimation method.

Table C-3. Surface Soil Arsenic Concentration Statistics for Smoky Canyon Mine Disturbance Areas

Disturbance Area		Arsenic Concentrations (mg/kg)													
		Date Range		Number of Samples	Detection Frequency	ND Concentration		Detected Concentration		Avg	95UCL	95UCL Estimation Method	Area Multiplier	Area-Weighted Statistic Based on Avg	Area-Weighted Statistic Based on 95UCL
Panel	Area (ac)	Min	Max			Min	Max	Min	Max						
Panel A	283	6/15/2010	6/16/2010	18	1			3.3	25.3	11.19	14.97	95% Adjusted Gamma UCL	0.235	2.6	3.5
Panel B [1]	129	Set to Pole ODA value		1	1			7.6	7.6	7.6	7.6	Set to Pole ODA value	0.107	0.8	0.8
Panel C [1]	70	Set to Pole ODA value		1	1			7.6	7.6	7.6	7.6	Set to Pole ODA value	0.058	0.4	0.4
Panel D	251	6/16/2010	6/18/2010	20	1			5.4	24.6	11.58	13.61	95% Student's-t UCL	0.209	2.4	2.8
Panel E	356	6/18/2010	6/22/2010	20	1			3.1	12.8	5.29	6.157	95% Student's-t UCL	0.296	1.6	1.8
Pole ODA [1]	113	3/3/2015	3/3/2015	1	1			7.6	7.6	7.6	7.6	Fewer than 4 detected values; used available value	0.094	0.7	0.7
Total Area (ac):	1202		**Total count:**	61					**Overall:**	9.26	10.54	95% H-UCL*	**Sitewide:**	8.59	10.16

Notes:

1 - Soil concentration is from a sample collected in the Dinwoody Borrow west of D-panel (material used for the Pole Canyon NTCRA cover). In this analysis, this arsenic concentration was also used for Panels B and C which have topsoil at the surface.

95UCL = 95th upper confidence limit on the mean

ac = acre

mg/kg = milligram per kilogram

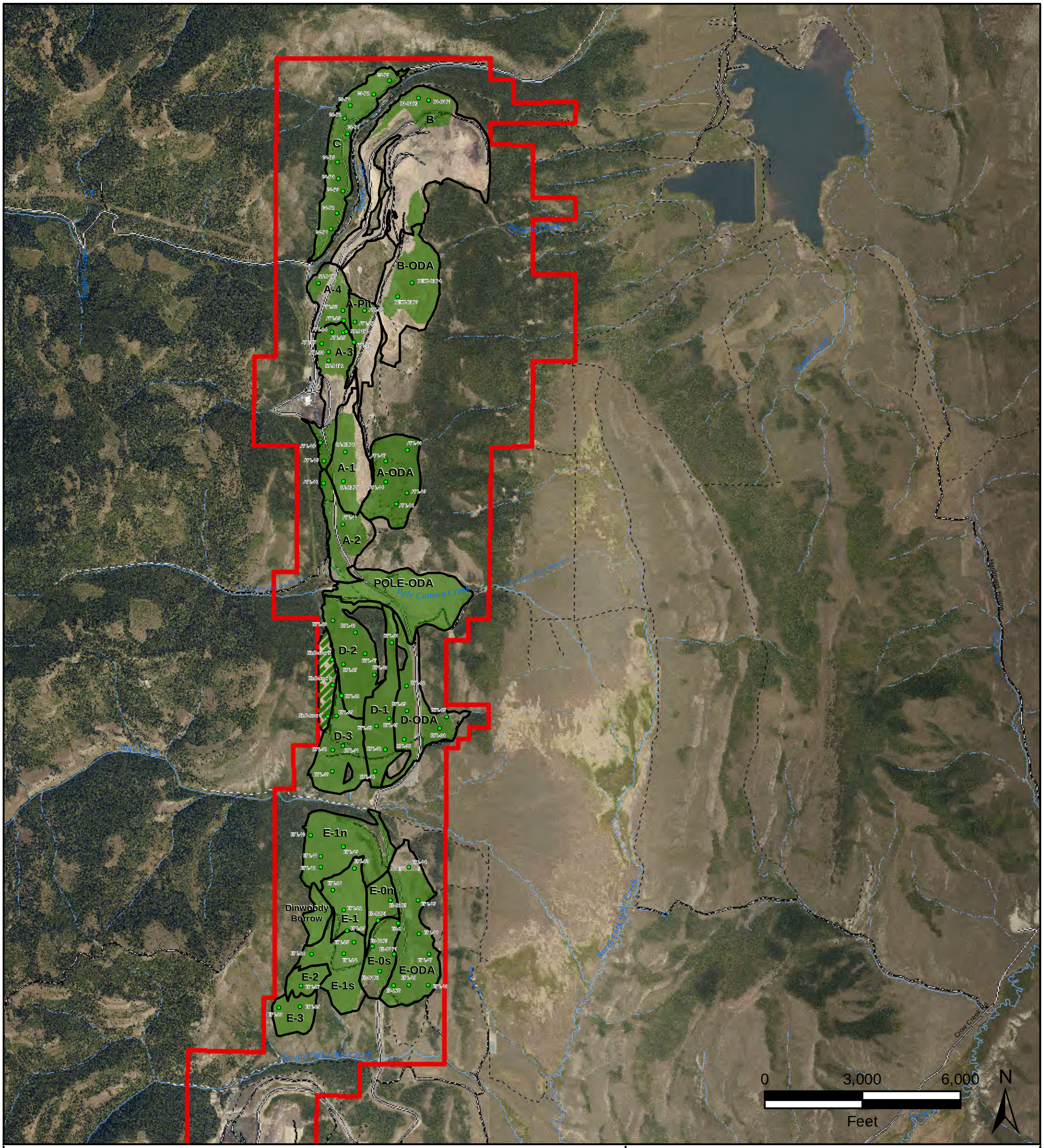
min = minimum; max = maximum; avg = average

ND = non-detected

Refer to Table C-1 and Figure C-1 for sampling locations included in the 95UCLs.

95UCLs were calculated using USEPA ProUCL software, version 5.1.002. First recommended value by ProUCL is provided, along with the 95UCL estimation method.

* The following message was provided by ProUCL: H-statistic often results in unstable values of UCL95. Use of nonparametric methods are preferred to compute UCL95. The non-parametric 95UCL for this dataset is 12.37 mg/kg (method 95% Chebyshev UCL).



Legend

- Feasibility Study (FS) Soil Dataset Locations
- Mine Pit/Panel Boundaries
- Reclaimed/Covered Area
- Dinwoody Borrow Area West of D-Panel
- Lease Area
- Minor Road
- Unimproved Road
- Trail (4WD)
- Trail (Other than 4WD)

J.R. SIMPLOT COMPANY

SMOKY CANYON MINE RI/FS

FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

FIGURE C-1

FEASIBILITY STUDY SOIL DATASET LOCATIONS

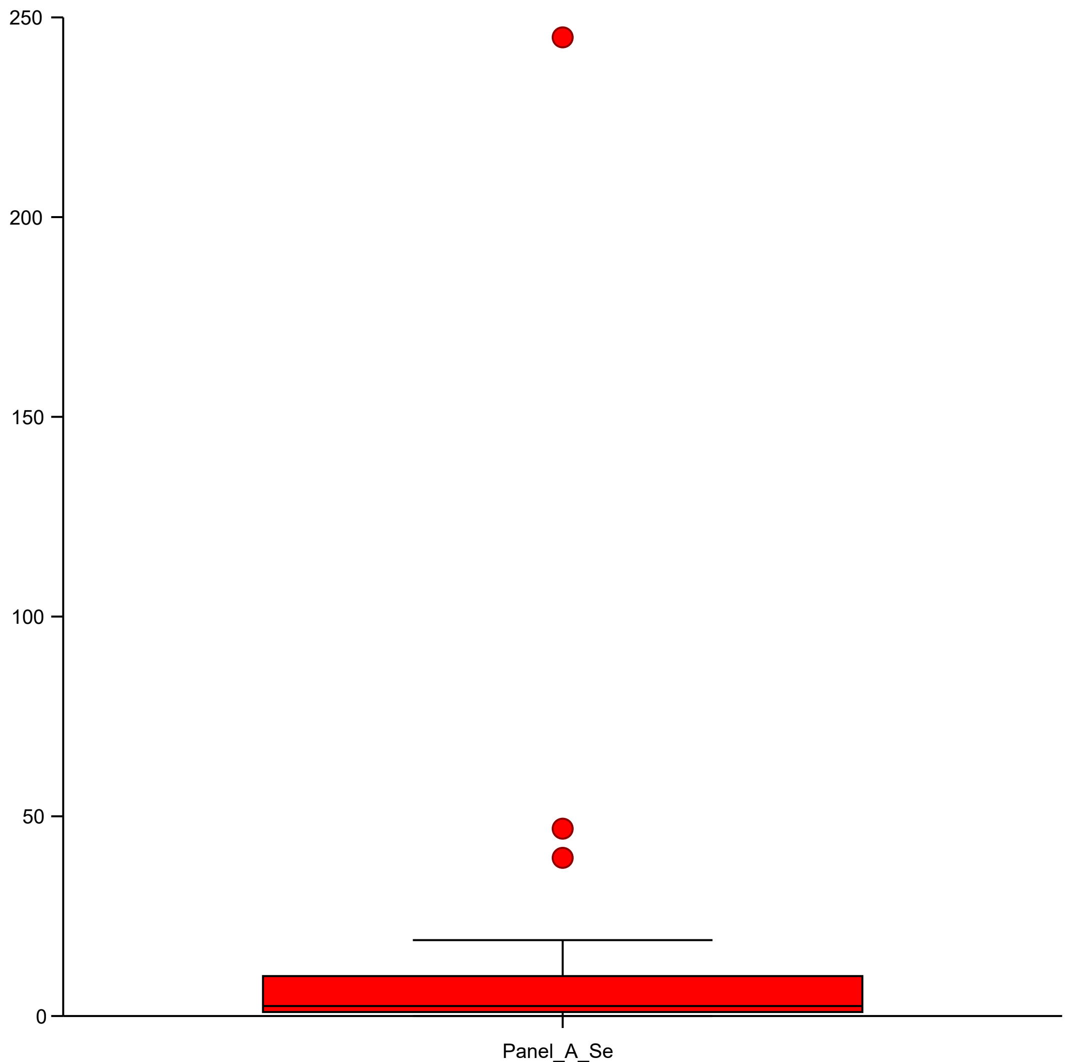
DATE: APR 06, 2020

BY: RCR | FOR: ACK

FORMATION ENVIRONMENTAL

S:\GIS\arcprj2\010109\plt\FS\TechMemo2\FigC-1_FSSoil.mxd

Box Plot of Selenium Concentrations in Panel A Soils



DRAFT

J.R. SIMPLOT COMPANY
SMOKY CANYON MINE RI/FS
FEASIBILITY STUDY TECHNICAL MEMORANDUM #2

FIGURE C-2

BOX PLOT OF SELENIUM CONCENTRATIONS IN PANEL A SOILS

DATE: APRIL 2020		FORMATION ENVIRONMENTAL
BY: RCR	FOR: ACK	

S:\Jobs\Smoky\CERCLA\FS\FSTM2\AppxC-Soil\FigC-2_APanelOutlier.ppx